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ANTITUBERCULOSIS MEASURES[1]

By Allen K. Krause

Seared and battered as few other epochs of the world the twentieth century is only completing its childhood; and, let us hope that its survival from maladies that only yesterday seemed mortal presages a sturdy and productive maturity and a mellow senescence. Were we required to characterize with a word the point of view,—the spirit,—that animated most of us with the birth of 1900 I believe that not a few would select "comfortable." Comfortable we were and comfortable we expected to remain. During the last two decades of the nineteenth century the conveniences of life had developed and multiplied to such an extent that what had once been the luxuries of the opulent, or had even been beyond their reach, had become everyman's necessities. And as the twentieth century added to its years, as its step became more certain and it began to reach out and grope for guidance into the mists of the illimitable future, it did so with far steadier hand perhaps than had ever drawn along any of the children of Time. For were we not at last masters of our environment? Had not the curse of our first parents lost most of its sting? Labor we must, yes,—and we must look forward ever to continue to labor. But we were to labor in a world such as our progenitors never dreamed of. Electricity now carried us to our shops. To press a button was to light our way into our homes when we returned at night. A turn of the switch in our living room and heat began to radiate through the house. Every home boasted of arrangements that made for cleanliness, and therefore health,—arrangements that were not available for even the regents of man of fifty years ago. Almost everyone of us could sit in his easy chair and talk with his friend at the other end of the city. From our old ashes we made us dyes of a variety and beauty that far surpassed those of the plants and beetles of the sleepy Orient, and we were led to develop our taste for ornament and for clothes; and possessing more than a necessity of clothes we were led further toward cleanliness and health.

Kindred examples might be multiplied at length. But what we would emphasize is that, if the tremendous increase and widespread distribution of comforts and conveniences made for any one specific thing, they promoted leisure—leisure, which in its enormous aggregate must have a not inconsiderable influence on the mass-manifestation of many human diseases, and particularly on such maladies that owe not a little to stress and strain to bring them to light. Among

[1] An address delivered under the title, "Some Aspects of the Problem," at the general meeting of the New Jersey Joint Conference on Tuberculosis, Perth Amboy, New Jersey, November 23, 1918.

such diseases tuberculosis undoubtedly takes its place. It is not my intention to discuss this phase of the situation to-day, except perhaps to refer to it occasionally in the course of my address. But before leaving it entirely I cannot refrain from calling attention to the large part that customs and modes of life, operating over long periods, changing slowly, almost inappreciably and yet very definitely, if we consider sharply outlined economic epochs, must play in influencing the morbidity and mortality statistics of a disease like tuberculosis. It will not hamper the student of tuberculosis if he is also familiar with the history of civilization.

By 1900 we had achieved a degree of physical comfort that was before unthought of and I do not think it an exaggeration to venture that we were approaching a comparatively stable state of comfortableness in our mental concepts. In morals? Well, every age is certain of the absolute rectitude of its moral aims, even though a comparative reading of Marcus Aurelius, of Machiavelli, of Bunyan, of Pepys, and of Wesley, leaves the infant mind a bit confused. In politics? At no time were we white men more certain of our God-given function of "benevolent assimilators" than in 1900. In economics? Capital, and we are all capitalists at heart, was never surer of its complete altruism,—things moved only because we of the dollars at great sacrifice hazarded our dollars to put the wheels in motion and save those of no-dollars from starvation. In applied science? Man had embalmed the human voice to resurrect it at will. He had begun to fly in the air and to sail his craft in the depths of the ocean. He was building cloud-piercing edifices to house a small city's people in a block. He was recording actual movement and actual colors in snap-taken pictures. And so on. Man could do anything. In medicine? Deep-lying structure revealed on a photographic plate; the disabilities of the human heart transcribed in peaks and waves on a film; the provocative causes of hitherto obscure infections discovered by the dozens; totally new and unfamiliar conflicts brought to light in the humors of the body;—all these and many more achievements accumulated to convince us of our mastery over the forces of Nature and to give us a comfortable sense of security as we faced the future.

And tuberculosis? Tuberculosis also caught something of the universal and contagious complacency. Becoming enthusiastic because of several remarkable discoveries made in rapid succession we began to make claims. Made bold by unexpected successes we began to predict. We could cure tuberculosis. We knew its cause—the tubercle bacillus. We were also sure of how the tubercle bacillus came to us. We could, therefore, choke it off at the source and prevent tuberculosis. Indeed, so flushed were we in the first days of our new knowledge that we set the date for the disappearance of tuberculosis, and few of us are so young that we cannot remember the banners that flaunted, "No tuberculosis by 1915!" Unmindful of the many disappointments of the past, careless of the one outstanding fact that is so familiar to the student of tuberculosis, namely, that almost every new discovery, almost every penetrating ray of light, once its full significance was appreciated, had never failed to indicate how much more complex was our problem than we had imagined, we pressed boldly on and made up our antituberculosis program.

This program was simple and it was direct. Based on the several plain facts that I have just outlined it was thoroughly logical and understandable. It is familiar to you all and may be summed up in a few words: institutions for the sick, the detection of disease at its very beginning, the control of the sources of infection.

Has it worked? I am told almost daily that it has not. But I always feel that the man who asserts that it has been a total failure and that it has contributed nothing to the salvation of the race is speaking altogether outside the facts. I know many men alive and highly productive to-day, who had the good fortune to become consumptive in the early nineteen-hundreds rather than in the eighteen-seventies. Thirty years before they would have been doomed to death and most of them would have died. I also know many "trained" consumptives who have fought their disease to a successful issue, and who have done this with their healthy babies around them, yet who fifty years ago would have sent many of these babies to scrofulosis and to death, and passed the blame therefor to their inherited taint. There can be no doubt that our program of control and our vulgarization of information have saved countless human lives and have prolonged ten times more. They have thus contributed tremendously to the potential and actual wealth of the world and have just as surely paid back to the people every penny they have ever received from them. A week's "sociological" inquiry will convince any unprejudiced person of these facts and should be sufficient to silence any destructive critic of the organized antituberculosis movement. But criticism there will remain and criticism there must remain if our work is to keep from stagnating and if our methods are to be kept so elastic that they can take advantage of the newer concepts that fresh contributions to knowledge are continually introducing.

Thoroughly convinced that the organized antituberculosis movement has exerted a tremendously salutary effect and just as certain that every man who is interested in any way whatever in the conquest of tuberculosis should wholeheartedly and unselfishly work toward a common end through one organized body, I nevertheless do not consider it conclusively proved that our organizations have always made full use of the more advanced knowledge of the day or that they have adopted all this newer information to themselves and applied it in all its implications and ramifications, no matter where these led. A certain fixity and non-development of the original plans, first bruited about the beginning of the century, have more than once impressed me. These plans, as I have said, were comparatively simple and direct. Few will disagree that they laid an overwhelming emphasis on the dangers of infection and on the necessity of paying attention to the sources of infection. In other words, they only followed the leading thought of the day, which was the outgrowth of the tremendous bacteriological bias that Koch and his followers saddled upon preventive medicine. They were formulated at a time when com-

mon opinion held that tuberculous infection and manifest tuberculosis in an adult were almost simultaneous occurrences. And if this appreciation of the tuberculosis situation had been a true one I believe that as a public health body our National Tuberculosis Association would have made far more progress in combating the disease than the steady strides it has already taken against a problem of almost incredible difficulty.

Our awakening began almost so gently that most of us refused to be stirred up. We may date the dawn of this new day to the Pirquet test. This simple manoeuvre, innocently put forward to aid us in diagnosis, to detect the consumptive even before he is aware of impending trouble, did not fulfill its original purpose. It did not point out who were tuberculous enough to be treated and who were not; and viewed from this angle it was a failure and exhibited a striking parallel to the fate of Koch's original attempts at the prevention and cure of tuberculosis. But never did a failure lead to more significant results! After several years,—after much grist had gone through the mill, it was found that the Pirquet test and all that it may mean had taught us many things that most of us would not have believed a decade before. Indeed, so multiform and far-reaching are its implications that it is my own opinion that with Laennec's promulgation of the unity of phthisis, Villemin's discovery of the infectiousness of tubercle and Koch's revelation of the bacillus, it makes up *the* quartet of really great episodes in the history of tuberculosis. And in some respects I consider the era of ideas—ideas, many of which are still relatively embryonic and formless—that it ushered in as the greatest of all.

It made absolutely certain what a very few sturdy souls had previously suggested and what still fewer admitted, namely, that the generality of mankind that lives in close association with its fellows harbors the tubercle bacillus; that is, that most of us become infected comparatively early in life. Try to think now of all the implications that this one bare fact conveys. What a vista of the ubiquity of the tubercle bacillus it at once opens up,—a ubiquity such as even the early bacillus hunters from Koch to Flügge never even dreamed of! Where then shall we begin in our search and control of sources of infection? Why, with the man of "positive" sputum, of course. Granted;—and that too would be relatively easy; but where shall we go next? Why to the manifestly ill who may not be emitting bacilli. Let us go even further and refine our diagnostic methods and attempt to ferret out those who are not yet ill but who are about to become ill. We won't quarrel over whether this is possible or not: we shall set out to do it. Yes, and where then?—for we have thus far accounted for only the veriest fraction of the human race that is carrying around tubercle bacilli.

But,—you protest,—what difference does it make if nine-tenths of the harborers of tubercle bacilli, all healthy men, do carry with them the seeds of consumption? They are "safe" men. They are well and are not distributing bacilli among their neighbors.

Yes, they are "safe." But they are "safe" only so long as they are "safe" and who is there anywhere so endowed that he can detect the moment, the day, the month, aye, in some cases the year, that they pass from being "safe" neighbors to a menace? And in this period of dawning disease, this indefinite time of diagnostic uncertainty before the patient seeks medical advice, how many cycles of infection, think you, can the patient initiate? It has always been my impression that by the time a very average and a very large number of us come to our physician because of our tired feeling, or our cough, or our lack of endurance, we have already fairly thoroughly tuberculized most of those who move within our range of intimate contact.

The Pirquet test gives us a method to make epidemiological studies such as is possessed by the students of no other disease. Equipped with it and its modifications we can roam the world and make observations on man and animals everywhere and, with an error that is surely less than ten per cent, detect who is tuberculous and who is not. And when we observe infection among the very young, whose voluntary range of contact is quite limited, we should more than once be led to the detection of previously unsuspected sources. Epidemiological studies have been made, but all have been too limited and too sporadic. And we await the day when the state, or men of vision and large resources, shall make it possible for us to have ideas that are definite and well grounded because they are based on sufficiently broad observations. It has just taken billions to still the voice of autocracy and brutishness, and mankind has gladly given up its billions. Yet the voice of Benedict Spinoza, that "God-intoxicated man," was stilled by the tubercle bacillus, and we go stumbling along in our search for truth for want of the thousands to lay bare the tricks of the eternal enemy of all mankind.

How significant becomes what the Pirquet test now teaches us! If most of us harbor the tubercle bacillus and if at the same time but a small percentage of us ever fall sick with tuberculosis then nothing can be more certain than that the development of manifest disease, the efflorescence of a "safe" man into a menace, depends not so much upon the mere presence in us of the seed,—in other words, upon infection,—as upon some other factor or factors that enter into our experience. Not all these factors are by any means familiar to us: indeed, we probably are acquainted with very few of them specifically. But I do not think that we generalize too rashly, if we are not too "scientific" to refuse to learn from clinical experience and say that a large proportion of the outbreaks of manifest tuberculosis are attributable to non-specific bodily effects that are brought about by what we may in general call "strain." Here we might classify the circulatory changes that are set up around old, unknown, and quiescent foci by such events, as pregnancy and labor, intercurrent disease, sudden intense or prolonged and more moderate physical effort, emotions such as anger or worry, abnormal habits or dissipation. Though its *modus operandi* is disputed, most men to-day agree that strain is an all-important factor in bringing tuberculosis into the realm of consciousness; and, if this

be granted, it must be equally true that its opposite, that is, relief or comparative relief from strain, will operate toward keeping quiescent tubercle in abeyance. It must therefore be perfectly certain that anything that leads to an amelioration of the general habits and conditions of life of masses or classes of people will work towards a subsidence of tuberculosis, epidemiologically speaking. And you will at once catch the drift of my remarks at the opening of this address that in appreciating the significance of the ups and downs of tuberculosis as a folk-disease we must also have some comprehension of the civilization of a people at any particular period that may be under consideration.

Our statistics, particularly those of the earlier decades, are anything but satisfactory and complete. Nevertheless they bring out one thing clearly. This is, that the tuberculosis mortality rate began to decline in practically every country, that was advancing industrially and was therefore increasing in wealth, as early as 1850 and for perhaps ten or twenty years before. This, remember, was thirty years before the discovery of the bacillus and when the disease was universally regarded as having a diathetic basis. In other words, tuberculosis began to abate its terrors before man intentionally applied a single measure to combat it. This fact must be familiar to you all and I shall not go into further detail concerning it. Personally, I can see only one reason for it, and this is the gradual bettering of the conditions of labor and living of the mass of the people that was ushered in markedly shortly before the middle of the last century and took on a tremendously accelerated impetus after 1880 and proceeded at an ever-progressing rate with only one or two brief interruptions (from 1893 to 1897 and in 1907) until the release of Armageddon in 1914.

Public health men have on occasion not been slow to seize upon this phenomenon and to throw it into the teeth of our antituberculosis boosters and boasters that figures showed that our own efforts had contributed nothing to a lessening of the greatest of all plagues but that this was brought about by forces that were intangible and over which we had no control. But truth is, that to speak thus is to argue, let us not say unfairly, yet nevertheless on a pinpoint. Such an assertion can be made in return like a boomerang upon the declarant. And, if we wished to draw comparisons and take a broader stand on the matter of infectious diseases in general, then following out the same line of argument, we should come dangerously close to a negation of the effect of public health work in general.

If we examine vital statistics we find that of the infectious diseases a decline in the death rate that began before what we may call the bacteriological era was not confined to tuberculosis alone. This is true of a number of diseases that we may call endemic in this part of the world,—of scarlet fever, of measles, of whooping cough, and of the enteric infections. We do not know the provocative causes of scarlet fever and measles, and cannot therefore combat them by specific measures. Yet scarlet fever has shown a marked decline, both in incidence and malignity, since about 1870. It must be obvious that as the habits and modes of living of a population change there must be many balancing and opposing forces set in motion which make both for and against the occurrence of infectious diseases. On the one hand, we should expect that the enormously accelerated condensation of population and the unexampled development of the means of communication that have been going on in the United States during the last thirty years would, if they were unopposed by contrary factors, favor the spread of many infections. But against such forces we may put the high development of home and office and factory sanitation, the better and more equable house heating brought about by central heating systems, the tremendously increased interest in out-door play and sports, the reduction of the hours of labor, the more general enjoyment of vacations,—in short, anything and everything that contribute to the amelioration of social and domestic life.

We now take our enormous office buildings as a matter of course. We have seen architects erect the impossible and we have long passed the time when anything that is built can elicit an expression of amazement from us. Yet we seldom stop to think that, even though we were in possession of all the secrets of the assembling of structural steel and even though we could install our present-day elevators, it would be absolutely impossible to use these great buildings, to bring together myriads upon myriads of people on the ground-space of an acre, if we could give them no better sanitary appliances than those that were in vogue as recently as thirty years ago. Our great buildings depend just as much for their erection on latter-day plumbing as they do upon the development of the elevator and the structural steel industry. And when we assemble people together as we do to-day, we are doing this under conditions that, as regards many infectious diseases, are relatively healthful compared with those that obtained only a few decades ago; and these physical conditions originated not in the minds of sanitarians and public health officials, but in that greatest of all stimuli for the betterment of man,—industrial ambition in its quest for wealth.

It must also be self-evident that as a community like that of Manhattan Island, in its necessity for growth and expansion, reclaimed and built up the vacant stretches and waste areas of land and erected buildings upon these, it unconsciously, with no thought whatever of public hygiene, brought about conditions that were unfavorable to the development of several infections. Malaria would be one of these; endemic typhoid fever, another. We might go on and develop this phase of the subject indefinitely. But I have already taken up perhaps too much of your time with it; and I have brought it in to illustrate that not all betterment of health conditions need be due to the intentional efforts of sanitarians, and to give point to what I feel, namely, that the public health official and "scientific" investigator, who now and again calls upon us to demonstrate mathematically the net results of our efforts and who seems inclined to dislocate credit from us to other broad and more or less intangible forces, had better analyze honestly just how many endemic infections he

has *by intentional intervention and by this alone,* diminished or subdued.

I am conscious of the enormous part that public health has played in making our residence on earth livable. As an outsider, I have always been proud of what our more enlightened and untrammelled executives have sought to do and have actually accomplished. But I also feel very strongly that, as a body and as an arm of the health service, our own National Association has never stood second to any in tangible results, that it has had as much definite information at its command as is at hand to combat any contact infection, that in the main it has used this well, and that because of its personnel it is unique and works with far more "motive" than any other aggregation of public servants in the world. For remember, the vast number of us are those who, having tasted, having felt, and having gained a personal and individual victory, have now enlisted in the most disinterested service. There are few of us who are in this fight for gain; still fewer for fame. But most of us work on because we have been taught by a great disciplinarian and because we would render back some of our mortal hours to the cause that gave them to us. And lest you think that I have now struck the level of sentimentality and that I am indulging more in oratory and in poetry than in fact, let me say that not so many years ago I expostulated with some heat with a man who has stood as high as any in our antituberculosis movement. I tried to point out to him that it was time wasted to spend so much of his precarious strength in public addresses and organized efforts to fight tuberculosis. And he replied that the movement initiated by Dr. Trudeau had given him back his life, that he owed everything he was and had to tuberculosis, and that the least he could do in return was to give up to it every minute he could spare. These were the words of a "lunger." And there are many others like him.

To come back to the disclosures of the Pirquet test. Let us ask how they square with the basic measures of prevention and control as these are embodied in our present program. Let us also seek to discover whether they teach us anything of value that might profitably be employed to supplement our orthodox efforts. But let us first run over briefly the chief weapons of defense that we now employ.

The institutional care of the tuberculous sick has proved its worth and has come to stay. It is yearly rescuing thousands of souls from an early grave or adding to their years. Fundamentally the principles that gave it birth are sound and will withstand any amount of shallow criticism. It has never yet been given a complete test for the simple reason that no community has as yet seen fit to appropriate enough money to take care of every one of its tuberculous patients for a proper length of time. But even though this could be done throughout the entire nation, there is not the shadow of a doubt that institutional care *of itself* would not solve the tuberculosis problem. It would not solve it because infections would still be taking place,—infections that planted the seeds of potential consumption. And infections would continue to take place because it is unthinkable that more than a moiety of patients would be detected before they had reached the "bacillary" stage, clinically speaking. Therefore, before entering sanatoria a large number will have tuberculized many with whom they live and associate. Properly speaking, institutions for the care of the tuberculous have but small place among the measures of prevention and control. They furnish abodes for reconstruction, education and rehabilitation, and should be looked upon as such. From the point of view of preventive medicine the greatest argument that can be brought forward from them is one of reasoning by analogy,—of comparing them with the lazar-houses that so successfully combated leprosy during the Middle Ages. But the analogy is not quite apt for reasons that would take us too far afield to discuss. We shall here content ourselves with pointing out merely the differences of infectiousness between the two diseases, the differences in onset, and the differences in termination between two diseases, one of which goes on inevitably and in the main progressively to death while the other is eminently a disease of "self-arresting" periods intermingled with relapses, progressions, and retrogressions, that no man can accurately predict, and not too many appreciate.

Even though it could be shown that under certain happy hypothetical conditions which so far as I know have no counterpart on earth, the incarceration of all consumptives would be eminently a preventive measure rather than one of reconstruction, its complete success would be of necessity absolutely dependent upon making a diagnosis in every case of tuberculosis in a stage that precedes the emission of bacilli. This I do not consider even quarter-way possible or practicable. After reading certain discourses on early diagnosis one would get the impression that the ordinary case of tuberculosis originates with the definiteness and abruptness of measles or the semi-obtrusiveness of typhoid fever. But I am confident that there is not a clinician here who will not agree with me that if there is any one feature that only too commonly characterizes the onset of tuberculosis it is that it comes on in such a way that for a considerable time the patient has not the least idea that he is an ill man. He has symptoms, it is true; but what are they? Only too often the same slight disabilities which he has frequently suffered before, and which he more than once shook off. A normal man, unaccustomed to introspection, to hypochondriasis, and to unecessary self-worry, will not run to a physician because of the slightest indefinite pain or lapse from full efficiency that oppresses him, and it is notorious how often we encounter these symptoms in people in whom we can find no organic basis for their complaints. It is just as notorious how often vague, indefinite and masked symptoms,—deviations from health that do not seriously interfere with a man's pursuit of his occupation—usher in the full expression of tuberculosis. And it is no less notorious how far a tuberculous process may progress anatomically before it addresses itself more eloquently to the patient. All this is so well recognized that I would hesitate to hazard even a guess as to the mean length of time that elapses between the first manifestation of illness and the seeking of medical advice in the ordinary patient who begins

his tuberculosis career as a case of chronic or indefinite onset. I only know this—that I have seen a prominent pediatrician present himself to the phthisiologist for the first time twelve years after his cough had begun. And he arrived with both lungs "riddled" and sputum loaded with bacilli. I have seen an eminent judge first ask for advice thirty-five years after his disease had given out its first warnings. And he came with cavitation in both lungs and a sputum count that would have caused Gaffky to create a new classification: yet he was a supreme court justice and had lost but few days of a busy lifetime from his labors. I also know of a pathologist who for eight years had the symptoms that we classify under the cardio-gastric type of onset, who at last had râles that came and went, and who finally went on to bilateral disease; yet although under constant observation by the best men he was not declared tuberculous until bacilli appeared in his sputum after nine years. The day of his first manifestation of bacilli must of course forever remain unknown, as must the damage that he did between the first "show" of bacilli and the time of their detection.

These cannot be exceptional instances. And they must make us wonder that, if such things are so, what then is going on among the more uninformed. We can only speculate: and I do not believe that the most florid imagination will over-daub the canvas. But if a large number of patients will not seek medical advice until some time after the first manifestation of symptoms, and if the diagnosis of pulmonary tuberculosis can offer insuperable difficulties to the best physicians—and I do consider that both these provisos are actualities that complicate the tuberculosis situation—then, it is manifest, that even though every medical man in the world possessed a degree of diagnostic skill that is at present unimaginable, there would still be ample opportunity left for a fair saturation of the world and the people who live therein with tubercle bacilli. And this statement of necessity carries with it the corollary that, as a measure of control and prevention, early diagnosis must ever be a limping sister.

No, to be *of itself* an adequate preventive method we should have to imagine that the following grotesque approach were workable, namely, that every man, woman and child submit, not monthly, but weekly or even daily, to physical examination and questioning by a competent clinician,—by one who has "tuberculosis judgment." I say not monthly but weekly or even daily, because tubercle bacilli that have been turned loose can get to many harbors in the space of a month. I use the term "competent" advisely, for reasons that must be apparent to all of you.

Whenever I think of early diagnosis, I think of it, not as a preventive measure essentially or as one of control, but, like institutional care, a salutary measure. And I am never tired of emphasizing that the more physicians there are or will come after us, who from a proper adjudication of history, symptoms, and signs can arrive at an appreciation of the earliest manifestations of clinical tuberculosis, the more human beings there will be who will be snatched from the ravages of the tubercle bacillus. It will reduce somewhat the chances of infecting others, but, if we honestly face all angles of the situation, the rôle it can play in limiting infection must be as a drop in the bucket. Nevertheless, because it is a life saver, it must ever remain the keystone of the clinical arch of tuberculosis.

We come now to the matter of infection. And here I must pray that I be not misunderstood.

As nearly as I can determine infection is the shibboleth of the antituberculosis campaign. Now and then I go to a tuberculosis exhibit. And what do I see? I see posters everywhere, portraying what we must avoid in this everyday life of ours if we are not to gather to ourselves the tubercle bacillus. I see very visible sneezes and coughs projected toward innocent bystanders. I see clouds of dust cast up by the sweeping broom to the nostrils of anyone who happens to be in the way. I see Susie using Johnny's tooth-brush. I see a pale, though heartless, mother imprint the kiss of instinct upon her baby's lips. All this and much more. And the implication is always plain. This dust, this mouth spray, this vicarious tooth-brush, this kiss, is the cause of consumption.

But is it?.

I shall answer by saying that I don't believe it is. It may propel into us the tubercle bacillus. It may even start the anatomical reaction of tubercle. But the number of times that it goes straight on to consumption is negligible,—so negligible that I don't think that we need concern ourselves about it.

Why should we concern ourselves about the *mere presence* of tubercle bacilli in our bodies? The Pirquet test has taught us that all who have taken their place in normal social intercourse have it attached to them. Yet the workers of the world go on, creating and undoing, and amassing and dissipating, all infected, yet few invalided. Considered by itself, therefore, mere infection is hardly worth paying attention to. It is the normal lot of man. The pessimist, upon first hearing of the universality of tuberculous infection, will throw up his hands and exclaim, "What's the use." The optimist will throw up his hat, and declare, "It can't be so bad after all. Everyone has it, yet few are sick."

We should take a far firmer hold on this fact than we have done heretofore. We should spread it broadcast. We should drive it home to every man that before adolescence tubercle is more common than hair on the face, and after forty, more common than hair on the head; and in a great proportion of instances not so troublesome, unless he makes it so. In 1900 it was infection that we were interested in; and naturally so, for it then meant disease. But to-day it is again consumption and its prevention that are our province, for we have learned of how little moment mere infection really is.

I have thus far not dwelt upon one phase of the antituberculous movement that organized effort has always made more than one-half of its program, and which must ever remain its chief function. This is education, so called.

But what is education? Whom shall we educate? And what information shall we impart?

In propagandism we speak much of education. Only too often we seem to imagine that its beginning and end are the dissemination of information. Yet real education is vastly more than this. To scatter broadcast and aimlessly what he knows is wasted time for any teacher. The process of education presupposes that, besides being given, our information is received, understood and assimilated. Only too often we teachers cast our pearls before swine. Only too often, too, we consider our function fulfilled when we have thus delivered ourselves of a weighty homily. And much of the education of health associations has, to my way of thinking, often proceeded in this haphazard fashion. Therefore, when I am told that to-day the people and the medical profession are already "educated" as regards tuberculosis, I react with a gesture of scepticism and unbelief. That tons of literature have been scattered to the four corners I do not doubt. But that pounds of what is really worth while have sunk in I do doubt.

The remedy? Why, teachers: teachers who can make their point, who can inspire and who can direct. If it be desirable to instruct youth to take its place in the world and make its living, how much more important is it that it be taught how to preserve its life! Under the patronage of the state a highly organized body of unselfish men and women are preparing our sons and daughters for the duties of life. And had I my way I would see to it that we of the National Association would select a great corps of the most elect of mankind, of teachers, and send these out to tell their fellowmen how they may preserve their lives. I should attempt to have these teachers trained in all the essential particularities of tuberculosis and of public health. I should send them to the people and I should send them to the physicians. And what would I have these told?

Much more than I can here take up to-night. But I would have emphasized that tuberculosis, a gaunt, manifest, upheaval of pulmonary infection, has its birth, not so much, if you please, in an ertswhile localization of the tubercle bacillus, but in any and every event that makes man unhealthy. I would have them told that to be spat upon or coughed upon by the man with the "common cold" did not upset me because I might merely acquire a cold quite so much as that this cold might fan my quiescent pulmonary tubercle into phthisis. I would have them told that the delicate woman who was about to fulfill her grandest function should be handled just a little differently from the sturdy one,—that her labor should be shortened, that her lactation be directed with the possibility of manifest tuberculosis ever kept in mind. I would have them told that over-strain, whether physical or mental, or that dissipation was to be avoided, not *because it lay them open to infection, but because it supplied the oil to a wick that was already present. I would have the emphasis laid on the behavior of the human being and not on the bacillus.* And I should thereby be contributing not only to a solution of the tuberculosis problem, according to the best information available, but also to that larger problem, that of public health in general.

After all, there are only two conceivable short cuts to the eradication of tuberculosis.

The first is the universal use of a remedial agent that would cure any and every type of disease without harm to the patient. We would presume that such a preparation would be bacillicidal. If it was capable of curing every case of manifest disease and could at the same time sterilize all tissues we would presuppose further that it could free from bacilli all foci that lay concealed in those without manifest disease. If, therefore, we were in possession of such a potent medicine, we could at any given time, by edict or by common agreement, administer it to all people and to all animals that are susceptible to the tubercle bacillus and at one grand stroke wipe out all tubercle bacilli that were in parasitic association with tissues. And this would undoubtedly mean the end of tuberculosis on earth.

The second short cut would be to administer to every non-tuberculous individual and to every new-born susceptible animal over a period of several generations a something that would immunize them in a way that they would be secure from any tubercle bacilli that attempted to gain lodgement in their bodies. This, manifestly, would be a more leisurely method than the first; for with only this weapon in our armamentarium, before the bacillus disappeared, we should be obliged to wait until the present myriads of victims,—our phthisical grandfathers and our tuberculous children as well,—squared accounts with their unwilling and ungrateful guests,—obligations of a kind that are never adjusted with finality till Death the only non-appellate arbiter comes between. The more halting of the two, this procedure would, none the less, also spell the end of tuberculosis.

Neither of these short cuts is in sight, nor can our generation hope to take the journey. Meanwhile I would stress that the prevention of tuberculosis is a prevention, not of infection, but of manifest disease; and that all our efforts should be directed to a supplementary reëducation of physician and layman alike, and the study of every factor that makes infection disease. And at the risk of unnecessary repetition I would also point out anew that there is no one shining beacon to lead us to the control and prevention of tuberculosis. The very complexity of the situation forbids this. I would not abate one jot or tittle of any tested method that we have employed. But I would take advantage of what the last decade has brought to us and lay the onus on the human individual rather than on the infecting microörganism.

The opportunity for service in antituberculosis work is tremendous: so tremendous as to appal the individual who for the first time casts his eye over the fields to be made over and the roads to be travelled. The opportunities for philanthropy are no less great and in no human endeavor will money spent yield more certain and richer returns. We must have a goal and this goal must be the complete taking-over of the tuberculosis situation throughout the world. We must cry for money and money and still more money, and never cease until the mass of mankind realizes the situation and is responding to it. Then and then only can we say that we are

in a position to wage a real battle against tuberculosis. An effective fight would presuppose an organization the spirit and model of which could be found only in the monastic orders of medieval times. Our sisterhood, made of up thousands who have given back their lives to tuberculosis, would live among the sick and bring them back to a measure of effectiveness. Our friars would go up and down the land instilling the people with the truth,—the truth of the universality of the tubercle bacillus, the truth of the magnitude of its mortal effect, the truth of the inciters of the tubercle bacillus to action, the truth that everything that makes for the internment of the tubercle bacillus within ourselves makes for better living and higher efficiency and that everything that makes for better living and higher efficiency makes for the internment of the tubercle bacillus. Without rest, without interruption or let-up, we must keep all this before the people, while our priors and our abbots are busy in recording the peculiar habits and characteristics of the enemy and the responses and reactions of the body to it. Acquisition of all information, broadening, intensification, growth, and development, must never cease in our plans of campaign. Apologetic we need not be and dare not be; and no real worker should be obliged to approach the shrine of wealth with hat in hand to ask for a pittance for the cause. It is the glory of mankind that it has always been responsive to necessity; and real information that brings about an adequate appreciation of the necessities of the situation will always loose the purse-strings.

Nor is there room in the antituberculosis movement for a single note of discouragement. The pessimists among us can be only those who are deficient in grasp and breadth. Civilization and tuberculosis are cotemporaneous; the number of the tuberculous and the number of civilized beings are almost coequal; therefore, to despair of tuberculosis is to despair of civilization. A graft that is as much a part of us as is the development of our ethical sense cannot be lopped off in a day; but it can be kept from flowering and bearing fruit. And until we can wage direct warfare on the germ, to keep it in the seed should be our main purpose.

PUBLICATIONS.

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INSUSCEPTIBILITY OF MONKEYS TO INOCULATION WITH BLOOD FROM MEASLES PATIENTS

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Measles, though usually a mild disease in itself, often leads to serious consequences; its involvement of the upper respiratory tract frequently facilitates the invasion of the lungs by the hæmolytic streptococcus or the pneumococcus. The resulting pneumonia has attracted considerable attention of late. Control of the hæmolytic streptococcal infections by specific vaccines or serum therapy is a difficult problem. A possible departure from this line of approach consists in the prevention of measles itself by the development of a prophylactic inoculation. The clinical features of the disease indicate the existence of an excellent theoretical basis for the development of a protective inoculation. One attack of measles confers a high degree of immunity, and the virulence of the causative organism is naturally so low that *per se* it does not produce fatal effects in man under ordinary conditions. The crucial problem is whether the virus of measles can be still further attenuated in such a manner that it would be suitable for prophylactic purposes.

On the recommendation of Colonel Frederick F. Russell the problem of prophylactic inoculation against measles is being investigated. Unfortunately, the causative organism of the disease is not known. A variety of bacteria have been cultivated from the blood and the mucous exudates of patients, but evidence of the etiologic importance of these organisms has not been produced. It has generally been considered that Hektoen,[1] by inoculations into man, has established the existence of the virus of measles in the circulating blood at least during the first day after the rash appears. Four groups of workers have reported on very slight evidence that monkeys are susceptible to the disease. These meager data constitute the essential features of the experimental work that has been conducted on measles.

Review of Literature.—In attempting the attenuation of the virus of measles, one of the first points obviously consists in determining the susceptibility of lower animals. Important symptoms have been attributed to the inoculation of the blood of measles patients into monkeys. Compiling the effects noted by various workers we have the following:

(1) Fever, (2) rash, (3) Koplik spots, (4) leucopœnia, (5) rhinitis and (6) malaise. Of these symptoms Anderson and Goldberger[2] noted especially the development of fever accompanied frequently by a rash, by coryza, rhinitis and malaise. Very significant or clearly marked results were reported for all monkeys injected with the blood taken from unquestionably early cases of measles, *i. e.*, within from 12 to 24 hours after the appearance of the rash. The very doubtful or negative results are considered as having occurred when the blood was withdrawn during the second day of the rash. Well-marked febrile reactions with an exanthem were obtained not only by the injection of serum, but also with very thoroughly washed red cells. Three species of monkeys were found susceptible to inoculation with blood, namely, *Macacus rhesus, M. cynomolgus* and *M. sinicus.*

Nicolle and Conseil[3] report the transmission of measles to a monkey (*M. sinicus*). They injected one animal with blood taken from a patient 24 hours before the appearance of the eruption; after an incubation period of nine days, a slight elevation of temperature occurred unaccompanied by any other symptoms.

Hektoen and Eggers[4] studied the leucopœnia and also the temperature reaction in *M. rhesus.* Two of three animals that were inoculated showed a transient rise in temperature; a pronounced drop in the white count was noted on the sixth day in one and on the ninth in the other, the leucopœnia persisting somewhat irregularly for several days. Differential counts showed the leucopœnia to be due principally to a drop in the polymorphonuclear cells. One animal apparently became ill on the 12th day and on the 15th a maculopapular eruption appeared and persisted for several days. No Koplik spots were seen. The development of a leucopœnia in *M. rhesus* after the inoculation of measles blood has been confirmed by Tunnicliff.[5]

Hektoen and Eggers interpret this leucopœnia as indicating a reaction to the virus of measles. Their results taken in conjunction with Anderson and Goldberger's work lead them to conclude that monkeys develop a mild kind of measles when injected with blood from patients taken soon after the rash has appeared.

Lucas and Prizer[6] selected a case of measles in a child and inoculated two monkeys with blood taken six hours before the appearance of the rash. These monkeys developed a transient erythema of the face, a leucopœnia and Koplik spots. These spots appeared on the 10th day after inoculation, but unfortunately the period of their duration was not recorded. It is not stated whether isolated spots were found or whether typical clusters occurred. No febrile reactions were obtained and the temperature of these animals was not reported. Unfortunately, these animals died about two weeks after inoculation from an intercurrent infection of unknown etiology. Several uninoculated control monkeys also died.

It is evident, then, that these studies are not very conclusive; the blood counts under these circumstances are particularly unreliable. Lucas and Prizer conclude that these monkeys were undoubtedly infected with measles.

Anderson and Goldberger, Hektoen and Eggers, Lucas and Prizer, report the successful passage of the virus of measles from monkey to monkey by the inoculation of blood. Anderson and Goldberger report six successive passages without any change in virulence. Nicolle and Conseil attempted on one occasion to subinoculate from one monkey to another, but without success.

Outline of Work.—In the following experiments, monkeys (*M. rhesus*) were inoculated from cases of measles occurring in adults 20 to 30 years of age. Blood was the only material used for inoculation, and in all cases it was withdrawn within the first 24 hours after the appearance of the rash. It was either defibrinated or collected in sodium citrate solution prepared in physiological saline. In some instances it was diluted with several parts of salt solution, according to the recommendations of Ricketts and Wilder[7] for the transmission of typhus to monkeys and also according to Hektoen and Eggers' work on measles. Observations on the inoculated animals were made each day about the middle of the forenoon, especial attention being given to the body temperature and the leucocyte count. The room temperature was also recorded, because, under normal conditions, the temperature of monkeys fluctuates somewhat. The buccal mucous membranes were examined from time to time for the appearance of Koplik spots. Excellent housing conditions were available for the animals, thereby avoiding any difficulty from the spontaneous development of rhinitis or coryza during the incubation period.

In order to test out any doubtful symptoms occurring in the inoculated monkeys, arrangements were made to inject blood from them into a susceptible human volunteer. In the selection of a human subject two points were given especial consideration, namely (1) assurance that the individual had never had a recognizable attack of measles, and (2) rejection of any individuals harboring pathogenic organisms in the respiratory passages.

It was found that very little dependence could be placed on the statement of even the educated adult that he had never had measles. Those men who could not remember an attack of the disease were asked to confer with their family; only those were accepted in whom there was no suspicion of an attack of either measles or rubella.

In addition to the routine physical examination, special care was taken to insure that the tonsils and sinuses were in good condition. In the case of enlarged tonsils, the hæmolytic streptococcus may occur in the crypts even when the surface of the gland is free from pathogenic bacteria.

Bacteriological examinations were made primarily for the hæmolytic streptococcus and pneumococcus. Examinations were also made for the meningococcus, the diphtheria and the influenza bacillus. Cultures were made over a period of from two to three weeks at intervals of from five to seven days, so that each individual was examined at least three times. As regards tuberculosis, attention was given to the history, the physical examination and the X-ray findings in the chest.

In considering the inoculation of a human subject precautions were taken against micro-organisms that might secondarily invade the blood stream of measles patients. It was necessary to avoid the possibility of carrying any such micro-organisms from the measles patients over to the monkeys and back again to a human subject. In making blood cultures in cases of measles, Tunnicliff[8] found a very considerable variety of bacteria. These secondary invaders appeared in the blood stream to an extent even greater than that occurring in scarlet fever. Therefore, we have made cultures on all specimens of blood inoculated into the monkeys.

Cultures were made aërobically in flasks of hydrocele meat infusion broth without sugar and also anaërobically according to the technique used by Plotz[9] in his work on typhus fever. For the anaërobic cultures, a few cubic centimeters of hydrocele fluid in ordinary test-tubes were inoculated with varying amounts of blood and the tubes filled with 2 per cent glucose meat infusion agar of a reaction to phenolphthalein corresponding to from 0.2 to 0.5 per cent of normal acid. Cultures were not discarded till after one month's incubation. Except for two contaminating colonies, no growth was obtained in seven cases cultured during the first day after the rash appeared. One of these patients was recultured during the second day of the rash with negative results. With a similar technique, Plotz also failed to obtain any growth from the blood of measles patients, studied as controls for his work on typhus fever.*

Results of the Inoculation of Monkeys.—Two adult monkeys were inoculated intraperitoneally, each from a different case of measles. Neither of these animals developed any symptoms that were diagnostic of the disease or that furnished any guide as to the most appropriate time for reinjection into a susceptible subject. It has been found that monkeys which fail to react to an injection of typhus blood may frequently respond to a subsequent injection; these two animals were therefore reinjected intraperitoneally with measles blood. At the same time a third normal monkey was also injected. In order to increase the opportunity for infection, these animals were injected every day for three successive days, each injection being made from fresh cases of measles.

On the first day, the normal monkey was injected into the heart and into the peritoneal cavity; all other injections of this and the other two animals were made intraperitoneally. Intracerebral inoculations were not used on account of the possible interference with the temperature reactions. There is no logical foundation for them in measles, and according to Anderson and Goldberger's results this method apparently possesses no superiority over intraperitoneal injection.

These monkeys were observed for a period of three and a half weeks after their last inoculation. No symptoms developed which differed in any essential way from changes

* Personal communication.

that were noted during control periods of observation. The temperature curves remained entirely normal. The white counts fluctuated considerably and occasionally would drop for a single day, but there was no leucopœnia that was sustained even for a short period. The temperature of Monkey I was somewhat elevated on the 15th and 16th days after the second series of inoculation, but the leucocyte count rose also at this time. In no case did we obtain the combination of a high temperature accompanied by a leucopœnia. Another monkey (II) developed a pronounced erythema with a few macules 10 days after inoculation, but this was hardly as marked as a similar rash which appeared in this animal one week before injection. It was not preceded nor accompanied by Koplik spots. The continued absence of lesions in the rather delicate mucous membrane would seem to militate against interpreting the skin eruption as due to measles. This same criticism applies to the rash without Koplik spots observed by Hektoen and Eggers.

Neither of the other two monkeys developed any lesions in the skin or mucous membranes. All three remained entirely free from conjunctivitis, rhinitis and coryza. There was no loss of appetite and no evidence of malaise.

Notwithstanding the negative results in these animals it is theoretically possible that the virus may have persisted and even multiplied without producing symptoms. Accordingly, the monkey (III) which had not previously been injected with measles was bled on the 11th day after the first of the three successive injections; after defibrination 3.5 c. c. of this blood was injected at once subcutaneously into a human volunteer. No symptoms developed. Anaërobic cultures of this blood showed no growth. Although this subject apparently never had measles, it is possible that he may have had an attack so mild as to be unrecognized yet sufficient to produce immunity. In order to obtain final proof that this specimen of blood did not contain the virus of measles it would be necessary to establish the susceptibility of this individual to measles. It is not justifiable to obtain such proof experimentally in view of the entirely negative results obtained in the monkeys.

On the basis of Hektoen's striking results it was assumed that the subcutaneous injection of a small amount of blood containing the virus of measles would reproduce the disease in man. In another series of investigations on prophylactic inoculation, a very unexpected result was obtained. One-half c. c. of serum from a fresh case of measles was inoculated subcutaneously without delay into an apparently susceptible individual; this quantity is several times larger than that used by Hektoen. This subject remained entirely free from any symptoms of the disease. This result in man casts a little additional doubt on the transmission of measles to monkeys by the inoculation of blood.

Discussion.—In the investigation of the circulating blood for the virus of measles, it would seem that trustworthy progress cannot be made by the inoculation of monkeys. Even though slight symptoms do develop in occasional individual animals it would appear that the results are too inconstant and indefinite to permit the practical use of this animal. Some more accurate means for the diagnosis of measles must be obtained before it can be clearly established that the monkey is, at times, infected by the injection of blood from early cases. It is conceivable that infection of this species with measles might be obtained in some other manner; for example, by scarifying the mucous membranes with the virus using perhaps the secretions from the respiratory tract instead of the blood of patients.

Anderson and Goldberger report that the injection into monkeys not only of bood serum, but also of very thoroughly washed corpuscles produced a well-marked reaction with an exanthem. This result suggests that the virus of measles occurs in the red cells as well as in the serum, since in the typical bacteriæmias the organisms adhering to washed corpuscles would hardly be sufficient to infect a distinctly refractory animal. However, there is good evidence that all of the diseases known to be caused by typical protozoan parasites of the red cells are transmitted by insects, whereas droplet infection constitutes the usual mode of propagation in measles. This apparently equal distribution of the virus of measles between the red cells and the serum is difficult to explain.

SUMMARY

1. Three monkeys were inoculated with the blood of measles patients taken early in the course of the disease from moderately severe cases. These animals remained entirely free from any symptoms that were either diagnostic or even suggestive of measles. Two of these animals that were injected a second time failed to develop any symptoms.

2. After an incubation period of 11 days blood was taken from one of these monkeys and injected into a human volunteer. No symptoms developed.

PROTOCOLS

The following data give the details concerning the injection of these monkeys; the record of their temperatures and white counts is given in full in order to provide the data on which we have based the interpretations given in the text. The temperature charts of the measles patients are given in order to show the stage of the febrile period at which the blood was withdrawn. This information as well as the statements concerning the time of appearance of the rash furnishes an indication of the period of the disease at which the subinoculations were made.

Monkey I was kept under observation for one week. Ten cubic centimeters of blood were taken from a case of measles (Patient A) 18 hours after the first appearance of the rash. This blood was diluted with 40 c. c. of physiological saline, then defibrinated and injected intraperitoneally. Chart I shows the temperature and white blood count of this animal. The temperature chart of the patient (Chart IV) shows that the blood was taken before the infection had begun to decline.

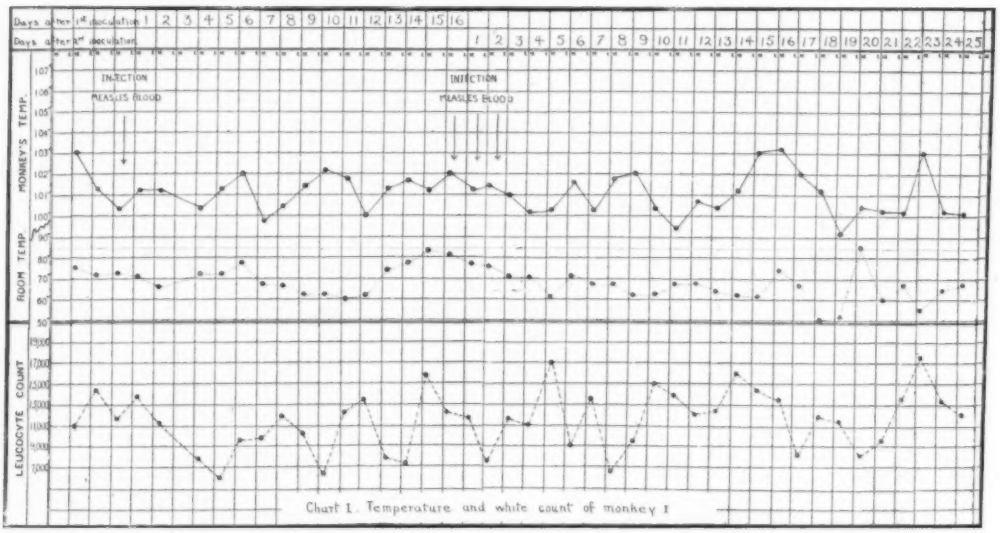
Days after 1st inoculation 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Days after 2nd inoculation 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
INJECTION MEASLES BLOOD
INJECTION MEASLES BLOOD
MONKEY'S TEMP.
ROOM TEMP.
LEUCOCYTE COUNT

Chart I. Temperature and white count of monkey I

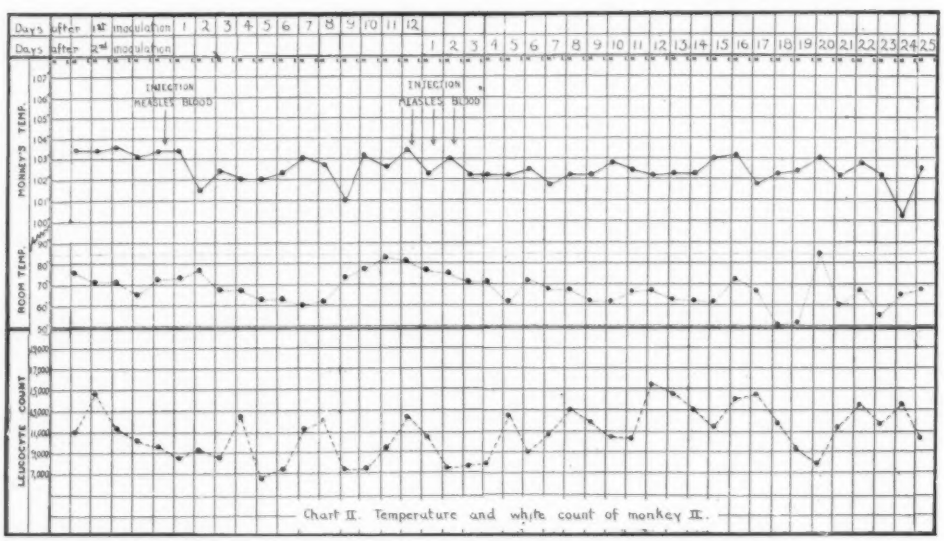
Days after 1st inoculation 1 2 3 4 5 6 7 8 9 10 11 12
Days after 2nd inoculation 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
INJECTION MEASLES BLOOD
INJECTION MEASLES BLOOD
MONKEY'S TEMP.
ROOM TEMP.
LEUCOCYTE COUNT

Chart II. Temperature and white count of monkey II.

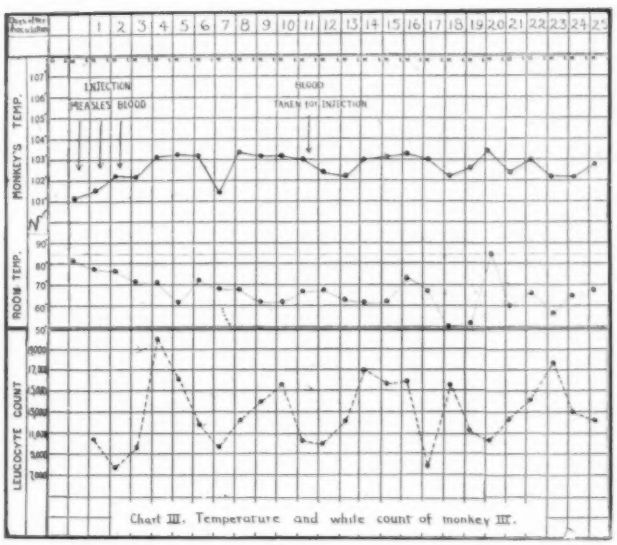
Days after Inoculation
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
MONKEY'S TEMP.
ROOM TEMP.
INJECTION MEASLES BLOOD
BLOOD TAKEN FOR INJECTION
LEUCOCYTE COUNT

Chart III. Temperature and white count of monkey III.

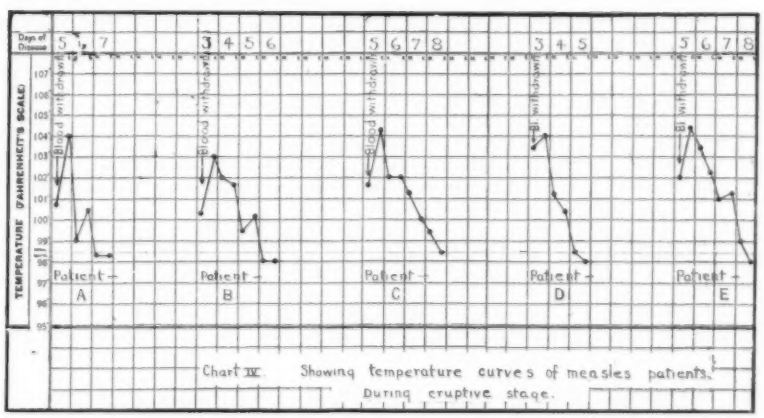

Chart IV. Showing temperature curves of measles patients during eruptive stage.

Sixteen days after this injection, this animal was reinoculated with measles blood taken from a patient (C) within from four to six hours after the rash had appeared. The blood was mixed with an equal part of 2 per cent sodium citrate in physiological saline. Of this mixture 15 c. c. were injected intraperitoneally. On the following day, 24 hours later, another injection was made with blood taken from a patient (D) 12 hours after the appearance of the rash. This specimen of blood was diluted with an equal part of physiological saline and defibrinated; 20 c. c. of this defibrinated mixture were injected intraperitoneally. After another interval of 24 hours a final injection was made with the blood of Patient E, taken not later than 12 hours after the rash had appeared. One part of blood was mixed with two parts of physiological saline and 20 c. c. of the defibrinated mixture were injected intraperitoneally. The effect of these injections is given in Chart I. The temperature charts of these patients are also given. (Chart IV.)

Monkey II was kept under observation for 10 days. Blood for injection was taken from Patient B within from 6 to 12 hours after the first appearance of the rash. The specimen was mixed with an equal part of physiological saline and 20 c. c. of the defibrinated mixture were injected intraperitoneally. The white blood counts and temperature of this animal are given in Chart II. The temperature of the patient is recorded in Chart IV. Before injection this animal had a marked erythema over the face and eyebrows; a few macules were also present. This rash faded during the first week of the incubation period, but increased somewhat 10 days after inoculation, though its intensity was not so great as during the period before injection. Since this time it has fluctuated considerably. At present, two months after the last injection, it is more marked than at any time during the incubation periods. Twelve days after the first injection of blood this monkey received injections of measles blood on three successive days; these injections were exact duplicates of those just recorded for Monkey I, the same specimens of blood being used.

Monkey III. This animal, a young adult, was given a series of three injections simultaneously with Monkeys I and II. The same specimens of blood were employed though the details were different. The injection on the first day consisted of 8 c. c. of the mixture of citrated blood injected into the heart and 12 c. c. intraperitoneally. On the second and third days 30 c. c. of the defibrinated mixtures were given intraperitoneally. The results in this monkey are recorded in Chart III.

REFERENCES

1. Hektoen: Jour. Infect. Dis., 1905, II, 238.
2. Anderson and Goldberger: Public Health Reports, 1911, XXVI, 847 and 887; Jour. Am. Med. Assn., 1911, LVII, 113, 476 and 971.
3. Nicolle and Conseil: Compt. Rend. Acad. Scien., 1911, CLIII, 1522.
4. Hektoen and Eggers: Jour. Am. Med. Assn., 1911, LVII, 1833.
5. Tunnicliff: Jour. Infect. Dis., 1912, XI, 474.
6. Lucas and Prizer: Jour. Med. Research, 1912, XXVI, 181.
7. Ricketts and Wilder: Jour. Am. Med. Assn., 1910, LIV, 463.
8. Tunnicliff: Jour. Infect. Dis., 1918, XXII, 462.
9. Plotz: Jour. Infect. Dis., 1915, XVII, 1.

THE PRODUCTION OF TETANY BY THE INTRAVENOUS INFUSION OF SODIUM BICARBONATE

REPORT OF AN ADULT CASE

By George A. Harrop, Jr.

(From the Medical Clinic of The Johns Hopkins Hospital)

Many drugs and chemicals have been mentioned as causing tetany in adults. Following Frankl-Hochwart,[1] it has been customary to classify all these conditions in one group, as due to toxins or poisons. The clinical history of a patient with tetany which was produced, or at least precipitated, by intravenous infusions of sodium bicarbonate follows:

L. H. Medical No. 39293. Colored. Aged 22. Domestic. Admitted, March 8, 1918. Died, March 18, 1918.

The *family* and *past history* were unimportant, except that the patient remembered no previous attacks which in any way suggested tetany, and the members of her family corroborated her statement.

Present Illness.—At 7.30 a. m. on the day of admission, before she had taken any food, she swallowed two 7½-grain tablets of bichloride of mercury, dissolved in a glass of water. Shortly afterward she vomited, and within an hour commenced to vomit blood. She was admitted to the hospital about noon. At this time she was vomiting dark colored material, and was very dull and drowsy.

Physical Examination.—Nothing abnormal was made out aside from tenderness and slight muscle spasm in the upper abdomen. The throat was red, but otherwise it showed nothing. All of the deep reflexes were normally active. No stigmata of rachitis could be found. Weight, 130 pounds. Mercury was recovered from the urine, feces, and vomitus.

Blood Examination.—W. B. C., 19,000. R. B. C., 5,624,000. Hemoglobin (Sahli), 90 per cent. Differential blood count normal. The Wassermann test was negative.

Course in the Hospital.—From the time of her admission the patient passed blood in her urine and stools. The usual energetic measures were taken to secure a large fluid intake and to eliminate the mercury.

On March 9 she became totally anuric and continued so until her death. On this day the plasma bicarbonate capacity (Van Slyke) was 45 volumes per cent, and the carbon dioxide tension of the alveolar air (Marriott) was 28 mm. of mercury. She was

[1] Frankl-Hochwart: Die Tetanie der Erwachsenen, Leipzig, 1907.

given 500 c.c. of a 5 per cent sodium bicarbonate solution intravenously.[2] No untoward effect was noted and she said that she felt more comfortable afterwards.

Twenty-four hours later (March 10), another intravenous infusion was given of 700 c.c. of a 5 per cent sodium bicarbonate solution, prepared as before. This made in all 60 grams of sodium bicarbonate given intravenously. A small amount given by mouth on March 9 had not been retained. About five minutes after this last infusion, which had been given slowly and had been apparently well taken, the patient's face suddenly grew pale, she commenced to have great inspiratory difficulty, and became very apprehensive. She complained of numbness and tingling of the fingers, and begged to have them rubbed. The hands assumed the typical obstetrical position, there was pedal spasm, and a first degree facial phenomenon (Chvostek's sign) was obtained. The pulse was accelerated to about 130, and the extremities became cold. There was no elevation of the blood-pressure. The acute attack lasted for about 15 minutes, after which the breathing became easier and she was less apprehensive. The *main d'accoucheur* position was maintained for about two hours.

On March 11 a blood sample was taken for the calcium and phosphate determinations recorded below, and at the same time for a determination of the plasma bicarbonate capacity (Van Slyke), which was found to be 80 volumes per cent. This sample was taken about 20 hours after the original attack. On this day a second degree Chvostek's sign was obtained and Trousseau's phenomenon was easily elicited.

The further history of the case has no bearing on the present discussion, except that Trousseau's phenomenon was present until March 15, and Chvostek's sign was obtained the night before her death, March 18. Commencing on March 12 there was pitting edema of the lower legs, and on March 15 evidence of the accumulation of a moderate ascites. She became very anemic from the continued bleeding from the bowel, the hemoglobin (Sahli) on March 17 being only 20 per cent.

[2] This was prepared by boiling a sodium bicarbonate solution made up with freshly distilled water, and then reconverting the carbonate so formed back into the bicarbonate by passing a stream of carbon dioxide through the solution until it was no longer colored by a few drops of phenolphthalein.

The writer has been unable to find any clinical reports of tetany occurring in adults following the administration of sodium bicarbonate. Among the many accidents following its use in the treatment of diabetic coma, the occurrence of convulsions, especially clonic in type, is frequently mentioned.[3] These convulsions have usually led to a rapidly fatal termination, often in a few hours. Tetany, however, has not been mentioned or identified as such. Howland and Marriott have observed tetany in young children following the therapeutic administration of sodium bicarbonate for acidosis and cite three cases.[4] During the period of tetany their patients showed a low calcium content of the blood serum, a condition which they have shown to be present during the active period of infantile tetany, particularly during or shortly after the occurrence of convulsions. The amount is usually then less than 7.0 mg. per 100 c. c. In the present case of adult tetany, analysis of the calcium content of a blood serum sample taken 20 hours after the original attack showed a value higher than 9.0 mg. per 100 c. c., hence about normal, and there was no marked accumulation of phosphates (the phosphate content of the blood serum was less than 6.0 mg. per 100 c. c.).[5] It should be noted, however, that in this case there had been no actual convulsions. It seems clear that the condition here was associated with, if not directly precipitated by, the suddenly increased alkalinity of the blood due to the sodium bicarbonate infusions.

In conclusion, it is desired to call attention to a danger, not too remote, attendant upon the intravenous use of sodium bicarbonate in conditions in which the renal excretory function is markedly impaired, and particularly when extreme oliguria or anuria is present.

[3] L. Blum: Ergeb. der inn. Med. u. Kinderh. 1913, XI, 480. "Symptomatologie und Therapie des Coma diabeticum."

[4] Quart. Jour. Med., 1918, XL, 289.

[5] The calcium and phosphate determinations were kindly made by Dr. Howland and Dr. Marriott.

CHANGES IN THE BLOOD IMMEDIATELY FOLLOWING TRANSFUSION

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The ever-increasing use of transfusion as a therapeutic measure has stimulated interest to seek a clear explanation for the various changes that follow the introduction into one individual of the blood of another. Nevertheless, some of the simplest questions raised by this procedure remain still unanswered. For instance, although it is generally known that after a transfusion the hemoglobin and the red corpuscle values are increased, the exact way in which the increase occurs is not understood. Many have assumed that the immediate effect is entirely mechanical, that is, that the blood of the recipient is altered in direct proportion to the quantity of the blood introduced, just as though the two had been mixed in a vessel outside of the body; that, later, reactions on the part of the blood-forming organs come into play, and these then take a part in determining the succeeding changes. No doubt the mechanical and reactive effects are both important, but the relative importance of each is not clearly defined, and the decision has practical value, because the outcome may influence us to use either small transfusions frequently repeated or larger transfusions at longer intervals.

Certain observations already at hand cast considerable doubt upon the view that the immediate effects of transfusion are purely mechanical and lead us at once to anticipate that these effects will be neither constant nor quantitative. Lamson [1] has shown how quickly and markedly the number of red cells in the circulation may be altered by the injection

of adrenalin. He is convinced by his experiments that the liver acts as a reservoir from which large numbers of red cells are poured into the circulation. No doubt other influences may act in the same prompt way upon this reservoir. Sellards and Baetjer,[2] from their experiments and a review of the entire subject, conclude that there is no constant nor quantitative response to the injection of foreign abnormal elements into the blood. The object of the present study is to obtain detailed and exact information upon the changes that occur in the blood elements immediately after transfusion.

METHODS

Transfusion was performed in each instance by a modification of the citrate method of Lewisohn, as described by Sydenstricker, Rivers and Mason.[3] The details of the technique need not be repeated here. Especial care was taken in testing the donors to be certain that the bloods were compatible. The amounts of blood given in different cases varied from 250 c. c. to 1250 c. c. Studies of the blood were made immediately before the injection, immediately after the injection, two hours, five hours and about twenty-four hours later. These time intervals were followed rather closely in practically all of the cases. Each examination consisted of counts of the red cells and of the white cells, with a differential count of 300 white cells. Platelets were estimated in the smears and the hemoglobin was determined. Notes were also made on the morphology of the blood cells. Counts were always made with the same instruments and by the same observer, with the same reagents; and care was taken to draw the blood from the same part of the body, with uniform punctures.

The effect of transfusion was studied in seven cases of pernicious anemia, two cases of idiopathic purpura, four of benzol poisoning, five of secondary anemia and two of Banti's disease.

RESULTS

Responses to transfusion were so variable that it seems desirable to append the detailed protocols. A few of the main points only will be summarized here.

Red Blood Cells.—In general, following the injection of blood, there was an immediate increase in the red cell count, the striking point being the marked increase in many cases apparently out of proportion to the quantity of blood introduced. Thus, in Case 2, the red count rose from 880,000 to 1,488,000 immediately after the injection of 500 c. c.; and in Case 5, from 480,000 to 1,300,000, following the injection of 650 c. c. Such remarkable changes indicate apparently a rapid redistribution of blood following an injection. In some cases the initial increase continued for several hours, usually falling, so that at the end of 24 hours the count had fallen to approximately where it was before transfusion. In other cases, however, there was a marked increase at the end of 24 hours. In several instances, after injection of blood, the count fell for a few hours and then rose slightly.

Hemoglobin.—The hemoglobin in most cases showed a uniform rise following transfusion, usually reaching its maximum at the end of 24 hours. In some cases the hemoglobin fell slightly after the initial rise. Changes in hemoglobin did not run parallel with changes in the red count, as may be seen best from the variations in the color indexes.

Leucocytes.—In practically every case following transfusion there was some increase in leucocytes. In several instances, however, they remained practically stationary or even fell. These relations do not seem to be constant in any particular type of case. The most striking change in the differential count is the increase in the polymorphonuclear neutrophiles, which was striking even in some cases where there was little change in the total leucocyte count. Occasionally a neutrophilic myelocyte was seen following transfusion, but they were not constant. In these cases no outpouring of nucleated red cells occurred, although in four instances a few were seen following transfusion, but not before. The numbers are so small, however, that this may have been accidental.

DISCUSSION

A general review of the immediate effect of transfusion upon the blood count in twenty cases does not reveal any constant changes following this procedure. The point of practical interest and importance seems to be that no exact mechanical effect can be demonstrated following the introduction of definite quantities of blood. Whereas, in a general way, it may be said that the introduction of blood raises the count, the effect is essentially a biological one involving the redistribution of blood in the body and its exact nature is not at present understood.

REFERENCES

1. Lamson: Jour. Pharmacol. and Exp. Therap., 1915, VII, 169.
2. Sellards and Baetjer: Bull. Johns Hopkins Hosp., 1918, XXIX, 135.
3. Sydenstricker, Mason and Rivers: Jour. A. M. A., 1916, 117, 719.

BLOOD CHART—CASE 1

PATIENT'S NAME, BRANT; WARD F; AGE, 47; MEDICAL NO., 124833; DIAGNOSIS, PERNICIOUS ANEMIA; TRANSFUSION, 1250 C. C.

Date	5-31-18	5-31-18	5-31-18	5-31-18	6-1-18	Remarks
Time	Before Transfusion 4.00 p. m.	After Transfusion 5.00 p. m.	7.00 p. m.	10.00 p. m.	4.00 p. m.	
	I	II	III	IV	V	
P. M. N.	143 47.6%	166 55.3%	141 47.0%	180 60.0%	227 75.6%	
P. M. E.	4 1.33%	5 1.66%	0 0	5 1.66%	0 0	
P. M. B.	0 0	0 0	0 0	0 0	1 0.33%	
L. Lym.	1 0.33%	0 0	4 1.33%	0 0	2 0.66%	
S. Lym.	146 48.6%	113 37.6%	97 32.3%	99 33.0%	40 13.3%	
L. Mono.	7 2.33%	8 2.66%	9 3.0%	3 1.0%	6 2.0%	
Trans.	4 1.33%	2 0.66%	4 1.33%	0 0	1 0.33%	
N. Myelocytes	0 0	0 0	0 0	8 2.66%	6 2.0%	
E. Myelocytes	0 0	0 0	0 0	0 0	0 0	
B. Myelocytes	0 0	0 0	0 0	0 0	0 0	
Myeloblasts	1 0.33%	0 0	0 0	0 0	0 0	
Smudges	14 4.66%	6 2.0%	45 15.0%	5 1.66%	17 5.66%	
Platelets	Markedly decreased.	Markedly decreased.	Markedly decreased.	Markedly decreased.	Markedly decreased.	
Nucleated R. B. C.	2—Intermediate, 1 Normoblast, 1	0 0	1—Megaloblast, 1	5—Normoblasts, 5	0 0	
	Moderate anisocytosis. Moderate poikilocytosis.	Moderate anisocytosis. Moderate poikilocytosis.	Moderate anisocytosis. Moderate poikilocytosis.	Moderate anisocytosis. Moderate poikilocytosis.	Moderate anisocytosis. Moderate poikilocytosis.	
Basophilia	Slightly diffused and punctate.	Slightly diffused and punctate.	Slightly diffused and punctate.	Slightly diffused and punctate.	Slightly diffused and punctate.	
No. Cells Counted and %.	300 99.91	300 99.98	300 99.96	300 99.98	300 99.98	
Hb.	60%	65%	66%	70%	70%	
R. B. C.	2,284,000	3,424,000	3,032,000	2,960,000	2,688,000	
W. B. C.	3,200	4,200	3,340	3,640	4,440	
C. I.	1.3	.95	1.0	1.2	1.3	
Condition of Patient	No chill; no fever.	No chill; no fever.	Slight fever.	Slight fever.	Slight fever.	
Blood Obtained	Little finger left hand.	Third finger left hand.	Little finger left hand.	Third finger left hand.	Little finger left hand.	Pt. transfused slowly in right arm.

BLOOD CHART—CASE 2

PATIENT'S NAME, PAVUK; WARD G; AGE, 30; MEDICAL NO., 123834; DIAGNOSIS, PERNICIOUS ANEMIA; TRANSFUSION, 500 C. C. 2D TRANSFUSION

Date	3-26-18	3-26-18	3-26-18	3-26-18	3-27-18	Remarks
Time	Before Transfusion. 3.55 p. m.	After Transfusion 4.15 p. m.	6.15 p. m.	9.30 p. m.	3.55 p. m.	
	I	II	III	IV	V	
P. M. N.	187 62.3%	199 66.3%	268 89.3%	246 82.0%	218 72.6%	These cells are very large in size, the majority with many lobed nuclei.
P. M. E.	9 3.0%	0 0	0 0	0 0	0 0	
P. M. B.	1 0.33%	0 0	0 0	0 0	0 0	
L. Lym.	8 2.66%	16 5.33%	4 1.33%	3 1.0%	10 3.33%	
S. Lym.	68 22.6%	57 19.0%	15 5.0%	30 10.0%	45 15.0%	
L. Mono.	4 1.33%	8 2.66%	10 3.33%	7 2.33%	10 3.33%	
Trans.	7 2.33%	11 3.66%	1 0.33%	6 2.0%	15 5.0%	
N. Myelocytes	6 2.0%	0 0	0 0	0 0	0 0	
E. Myelocytes	0 0	0 0	0 0	0 0	0 0	
B. Myelocytes	0 0	0 0	0 0	0 0	0 0	
Myeloblasts	3 1.0%	1 0.33%	0 0	0 0	0 0	
Smudges	7 2.33%	8 2.66%	2 0.66%	8 2.66%	2 0.66%	
Platelets	Practically absent.	Moderately diminished.	Markedly diminished.	Moderately diminished.	Moderately diminished.	
Nucleated R. B. C.	1—Normoblast, 1	1—Normoblast, 1	1—Normoblast, 1	3—Normoblasts, 3	0 0	
	Marked anisocytosis. Marked poikilocytosis.	Marked anisocytosis. Moderate poikilocytosis.	Slight anisocytosis. Slight poikilocytosis.	Marked anisocytosis. Moderate poikilocytosis.	Moderate anisocytosis. Moderate poikilocytosis.	
Basophilia.	Slightly diffused.	Slightly diffused and punctate.	Slightly diffused.	Slightly diffused.	Slightly diffused.	
No. Cells Counted and %.	300 99.98	300 99.94	300 99.95	300 99.99	300 99.92	
Hb.	19%	25%	30%	30%	32%	
R. B. C.	880,000	1,488,000	1,512,000	1,416,000	1,568,000	
W. B. C.	3,800	4,300	8,700	5,450	3,700	
C. I.	1.1	0.89	1.0	1.0	1.0	
Condition of Patient	No chill; no fever.	No chill; no fever.	Slight fever.	Fever.	No chill; no fever.	
Blood Obtained	Little finger right hand.	Third finger right hand.	Little finger right hand.	Third finger right hand.	Little finger right hand.	Pt. transfused slowly in left arm.

BLOOD CHART—CASE 3

PATIENT'S NAME, PAVUK; WARD G; AGE, 30; MEDICAL NO., 123834; DIAGNOSIS, PERNICIOUS ANEMIA; TRANSFUSION, 500 C. C.

Date	3-12-18	3-12-18	3-12-18	3-12-18	3-13-18	Remarks
Time	Before Transfusion 11.00 a. m.	After Transfusion 12.25 p. m.	2.25 p. m.	5.25 p. m.	11.00 a. m.	
	I	II	III	IV	V	
P. M. N.	194 64.6%	252 84.0%	267 89.0%	235 78.3%	223 74.3%	Very large in size; many lobes.
P. M. E.	0 0	0 0	0 0	0 0	2 0.66%	
P. M. B.	1 0.33%	0 0	0 0	0 0	0 0	
L. Lym.	5 1.66%	0 0	1 0.33%	1 0.33%	6 2.0%	Path. lymphocyte seen in III, IV and V.
S. Lym.	80 26.6%	30 10.0%	22 7.33%	37 12.3%	42 14.0%	
L. Mono.	8 2.66%	5 1.66%	2 0.66%	8 2.66%	9 3.0%	
Transitional	8 2.66%	5 1.66%	2 0.66%	4 1.33%	7 2.33%	
N. Myelocytes	0 0	1 0.33%	0 0	4 1.33%	5 1.66%	
E. Myelocytes	0 0	0 0	0 0	0 0	0 0	
B. Myelocytes	0 0	0 0	0 0	0 0	0 0	
Myeloblasts	2 0.66%	1 0.33%	0 0	2 0.66%	3 1.0%	
Smudges	2 0.66%	6 2.0%	6 2.0%	9 3.0%	3 1.0%	
Platelets	Moderately decreased.	Moderately decreased.	Practically absent.	Practically absent.	Practically absent.	
Nucleated R. B. C.	6—Normoblast, 4 Intermediate, 1 Megaloblast, 1	0 0 Marked anisocytosis. Marked poikilocytosis.	2—Megaloblast, 2	2—Normoblast, 2	Those seen larger in size and bizarre in shape. 1—Intermediate, 1	
Basophilia	Moderately diffused and punctate. Marked anisocytosis. Marked poikilocytosis.	Slightly diffused and punctate.	Slightly diffused and punctate. Marked anisocytosis. Marked poikilocytosis.	Slightly diffused and punctate. Marked anisocytosis. Marked poikilocytosis.	Slightly diffused and punctate. Marked anisocytosis. Marked poikilocytosis.	
No. Cells Counted and %.	300 99.83	300 99.98	300 99.98	300 99.81	300 99.95	
Hb.	10%	15%	10%	10%	15%	
R. B. C.	624,000	920,000	832,000	808,000	1,096,000	
W. B. C.	1,377	3,040	3,160	1,680	1,800	
C. I.	0.83	0.83	1.0	1.0	0.75	
Condition of Patient	No chill; no fever.	No chill; no fever.	Fever.	Fever.	No chill; no fever.	
Blood Obtained	Little finger left hand.	Third finger left hand.	Little finger left hand.	Third finger left hand.	Little finger left hand.	Pt. transfused slowly in right arm.

BLOOD CHART—CASE 4

PATIENT'S NAME, ALEXANDER; WARD F; AGE, 33; MEDICAL NO., 125655; DIAGNOSIS, PERNICIOUS ANEMIA; TRANSFUSION, 750 C. C.; 2D TRANSFUSION

Date	6-29-18		6-29-18		6-29-18	6-29-18	6-30-18	Remarks
Time	Before Transfusion 11.00 a. m.		After Transfusion 12.25 p. m.		2.25 p. m.	5.25 p. m.	11.00 a. m.	
	I		II		III	IV	V	
P. M. N.	146	48.6%	148	49.3%	219	73.0%	177	59.0%	202	67.3%	A few pathol. lymphocytes seen in I, II, III.
P. M. E.	11	3.66%	12	4.0%	8	2.66%	14	4.66%	5	1.66%	
P. M. B.	0	0	0	0	1	0.33%	1	0.33%	2	0.66%	
L. Lym.	4	1.33%	1	0.33%	0	0	0	0	1	0.33%	
S. Lym.	123	41.0%	129	43.0%	62	20.6%	95	31.6%	57	19.0%	
L. Mono.	6	2.0%	3	1.0%	3	1.0%	4	1.33%	12	4.0%	
Transitional	7	2.33%	5	1.66%	2	0.66%	5	1.66%	2	0.66%	
N. Myelocytes	0	0	0	0	0	0	0	0	7	2.33%	
E. Myelocytes	0	0	0	0	0	0	0	0	0	0	
B. Myelocytes	0	0	0	0	0	0	0	0	0	0	
Myeloblasts	3	1.0%	2	0.66%	1	0.33%	0	0	1	0.33%	
Smudges	0	0	0	0	4	1.33%	4	1.33%	11	3.66%	
Platelets	Markedly diminished.		Markedly diminished.		Markedly diminished.	Markedly diminished.	Practically absent.	
Nucleated R. B. C.	0	0	1—Normoblast, 1		0	0	0	0	4—Megaloblast, 4	
Basophilia	Marked anisocytosis. Marked poikilocytosis. Slightly diffused and punctate.		Marked anisocytosis. Marked poikilocytosis. Slightly diffused and punctate.		Moderate anisocytosis. Moderate poikilocytosis. Slightly diffused.	Moderate anisocytosis. Moderate poikilocytosis. Slightly diffused.	Marked anisocytosis. Slight poikilocytosis. Slightly diffused.	
No. Cells Counted and %	300	99.92	300	99.95	300	99.91	300	99.97	300	99.93	
Hb.	44%		51%		53%	55%	58%	
R. B. C.	2,080,000		3,048,000		2,632,000	2,706,000	3,864,000	
W. B. C.	2,600		3,100		3,400	3,040	3,400	
C. I.	1.1		.85		1.0	1.0	.76	
Condition of Patient	No chill; no fever.		No chill; no fever.		Slight fever.	Slight fever.	No chill; no fever.	
Blood Obtained	Little finger right hand.		Third finger right hand.		Little finger right hand.	Third finger right hand.	Little finger right hand.	Pt. transfused slowly in left arm.

BLOOD CHART—CASE 5

PATIENT'S NAME, BAILEY, IRWIN; WARD M; AGE, 30; MEDICAL NO., 121999; DIAGNOSIS, PERNICIOUS ANEMIA; TRANSFUSION 650 C. C.; 2D (1ST TRANSFUSION 12-15-17, 500 C. C.; WASHED CELLS)

Date	12-18-17		12-18-17		12-18-17	12-18-17	12-19-17	Remarks
Time	Before Transfusion 2.30 p. m.		After Transfusion 3.45 p. m.		5.45 p. m.	8.45 p. m.	2.30 p. m.	
	I		II		III	IV	IV	
P. M. N.	189	63.0%	217	72.3%	257	83.3%	241	80.3%	267	89.0%	
P. M. E.	1	0.33%	2	0.66%	0	0	0	0	2	0.66%	
P. M. B.	0	0	0	0	0	0	0	0	1	0.33%	
L. Lym.	28	9.33%	10	3.33%	3	1.0%	2	0.66%	3	1.0%	
S. Lym.	68	22.6%	68	22.6%	37	12.3%	50	16.6%	24	8.0%	
L. Mono.	2	0.66%	0	0	0	0	0	0	0	0	
Transitional	2	0.66%	1	0.33%	1	0.33%	1	0.33%	0	0	
N. Myelocytes	..	..	..	..	..	..	..	..	..	..	
E. Myelocytes	..	..	..	..	..	..	..	..	..	..	
B. Myelocytes	..	..	..	..	..	..	..	..	..	..	
Myeloblasts	..	..	..	..	..	..	..	..	..	..	
Smudges	10	3.33%	2	0.66%	2	0.66%	6	2.0%	3	1.0%	
Platelets	Markedly decreased, large in size.		Greatly decreased, large in size.		Greatly decreased, large in size.	Greatly decreased in size.	Markedly decreased, not large in size.	
Nucleated R. B. C.	5—Megaloblasts, 2 Normoblasts, 3		3—Normoblast, 3		0	0	0	0	0	0	
Basophilia	Microcytes and macrocytes. Megalocytes. Slightly diffused and an occasional punctate. Anisocytosis. Poikilocytosis.		Microcytes and macrocytes. Megalocytes. Slightly diffused. Marked anisocytosis. Marked poikilocytosis.		Microcytes and macrocytes. Megalocytes. Slightly diffused. Marked anisocytosis. Marked poikilocytosis.	Microcytes and macrocytes. Megalocytes. Slightly diffused. Marked anisocytosis. Marked poikilocytosis.	Microcytes and macrocytes. Megalocytes. Slightly diffused and punctate. Marked anisocytosis. Marked poikilocytosis.	
No. Cells Counted and %	300	99.91	300	99.98	300	99.99	300	99.99	300	99.99	
Hb.	Estimated (Sahli). 3%		12%		20%	23%	23%	
R. B. C.	480,000		1,360,000		1,456,000	1,324,000	1,312,000	
W. B. C.	5,080		5,640		5,960	6,000	4,360	
C. I.	0.37		0.47		0.71	0.84	0.88	
Condition of Patient	No chill; no fever.		No chill; slight fever.		Slight fever.	Slight fever.	Slight fever.	
Blood Obtained	Little finger right hand.		Third finger right hand.		Little finger right hand.	Third finger right hand.	Little finger right hand.	Blood transfused in left arm slowly.

BLOOD CHART—CASE 6

PATIENT'S NAME, CROCKETT; WARD G; AGE, 65; MEDICAL NO., 120650; DIAGNOSIS, PERNICIOUS ANEMIA; TRANSFUSION, 500 C. C.

Date	10-22-17		10-22-17		10-22-17	10-22-17	10-23-17	Remarks
Time	Before Transfusion 11.45 a. m.		After Transfusion 12.40 p. m.		2.40 p. m.	5.40 p. m.	11.45 a. m.	
	I		II		III	IV	V	
P. M. N.	108	36.0%	98	32.6%	212	70.6%	238	79.3%	108	36.0%	
P. M. E.	3	1.0%	1	0.33%	2	0.66%	0	0	3	1.0%	
P. M. B.	1	0.33%	0	0	0	0	0	0	4	1.33%	
L. Lym.	75	25.0%	60	20.0%	15	5.0%	14	4.66%	46	15.3%	
S. Lym.	79	26.3%	100	33.3%	53	17.6%	32	10.6%	77	25.6%	
L. Mono.	4	1.33%	1	0.33%	1	0.33%	0	0	1	0.33%	
Transitional	4	1.33%	3	1.0%	3	1.0%	3	1.0%	5	1.66%	
N. Myelocytes	2	0.66%	2	0.66%	..	..	..	..	0	0	
E. Myelocytes	..	..	..	..	..	..	..	..	0	0	
B. Myelocytes	..	..	..	..	..	..	..	..	1	0.33%	
Myeloblasts	..	..	..	..	..	..	..	..	..	..	
Smudges	24	8.0%	35	11.6%	14	4.66%	13	4.33%	55	18.3%	
Platelets	Normal; large in size.		Normal; large in size.		Increased; large in size.	Increased; large in size.	Normal; large in size.	
Nucleated R. B. C.	8—Microblasts, 3 Normoblasts, 5		18—Microblasts, 4 Normoblasts, 14		13—Microblasts, 3 Normoblasts, 9 Intermediate, 1	5—Microblasts, 1 Normoblasts, 3 Intermediate, 1	6—Microblasts, 2 Normoblasts, 1 Intermediate, 2	
Basophilia	Many microcytes and macrocytes. Markedly diffused and punctate. Marked anisocytosis. Marked poikilocytosis.		Many microcytes and macrocytes. Markedly diffused and punctate. Marked anisocytosis. Marked poikilocytosis.		Few microcytes and macrocytes. Markedly diffused and punctate. Slight anisocytosis. Slight poikilocytosis.	Few microcytes and macrocytes. Markedly diffused and punctate. Slight anisocytosis. Slight poikilocytosis.	Diffused and punctate. Slight anisocytosis. Slight poikilocytosis.	
No. Cells Counted and %	300	99.95	300	98.72	300	99.85	300	99.89	300	99.85	
Hb.	20%		35%		34%	32%	31%	
R. B. C.	1,176,000		1,432,000		1,592,000	1,856,000	1,368,000	
W. B. C.	5,000		6,320		7,800	7,840	8,200	
C. I.	0.90		1.2		1.1	0.88	1.1	
Condition of Patient	No chill; no fever.		No chill; no fever.		No chill; no fever.	No chill; no fever.	No chill; no fever.	
Blood Obtained	Little finger left hand.		Third finger left hand.		Little finger left hand.	Third finger left hand.	Little finger left hand.	Blood transfused in right arm, slowly, then rapidly.

BLOOD CHART—CASE 7

PATIENT'S NAME, WHITE; WARD F; AGE, 50; MEDICAL NO., 122613, DIAGNOSIS, PERNICIOUS ANEMIA; 2D TRANSFUSION, 600 C. C. (1ST TRANSFUSION, 2-3-18)

Date	2-17-18	2-17-18	2-17-18	2-17-18	2-18-18	Remarks
Time	Before Transfusion 10.45 a. m.	After Transfusion 12.20 a. m.	2.20 p. m.	5.25 p. m.	10.45 a. m.	
	I	II	III	IV	V	
P. M. N.	140 46.6%	161 53.6%	222 74.0%	246 82.0%	219 73.0%	
P. M. E.	0 0	3 1.0%	1 0.33%	0 0	3 1.0%	
P. M. B.	0 0	0 0	0 0	0 0	1 0.33%	
L. Lym.	6 2.0%	8 2.60%	1 0.33%	4 1.33%	2 0.66%	
S. Lym.	129 43.0%	84 28.0%	50 16.6%	27 9.0%	51 17.0%	
L. Mono.	5 1.66%	11 3.66%	6 2.0%	8 2.66%	4 1.33%	
Transitional	8 2.66%	11 3.66%	9 3.0%	8 2.66%	5 1.66%	
N. Myelocytes	0 0	4 1.33%	8 2.66%	1 0.33%	5 1.66%	
E. Myelocytes	0 0	0 0	0 0	0 0	0 0	
B. Myelocytes	0 0	0 0	0 0	0 0	0 0	
Myeloblasts	0 0	1 0.33%	0 0	1 0.33%	0 0	
Smudges	12 4.0%	17 5.66%	3 1.0%	5 1.66%	10 3.33%	
Platelets	Decreased moderate.	Decreased slightly; some very large.	Normal; some large in size.	Markedly decreased. Some large in size.	Normal; some large in size.	
Nucleated R. B. C.	2—Normoblasts.	5—Normoblast, 4 Intermediate, 1	27—Normoblast, 21 Intermediate, 6	2—Normoblast, 1 Intermediate, 1	8—Normoblast, 7 Megaloblast, 1	
Basophilia	Slightly diffused. Slight anisocytosis. Slight poikilocytosis.	Diffused and punctate. Slight anisocytosis. Slight poikilocytosis.	Slightly diffused and punctate. Slight anisocytosis. Slight poikilocytosis.	Slightly diffused and punctate. Moderate anisocytosis. Moderate poikilocytosis.	Slightly diffused and punctate. Moderate anisocytosis. Moderate poikilocytosis.	
No. Cells Counted and %.	300 98.92	300 99.70	300 99.92	300 99.97	300 99.97	
Hb.	35%	44%	46%	46%	48%	
R. B. C.	1,288,000	2,184,000	2,640,000	2,748,000	2,448,000	
W. B. C.	3,720	2,760	2,400	3,960	3,560	
C. I.	1.4	1.0	0.88	0.85	1.0	
Condition of Patient	No chill; no fever.	No chill; no fever.	Severe chill; fever.	Fever.	No chill; no fever.	
Blood Obtained	Little finger right hand.	Third finger right hand.	Little finger right hand.	Third finger right hand.	Little finger right hand.	Blood transfused slowly in left arm.

BLOOD CHART—CASE 8

PATIENT'S NAME, HOPKINS; WARD M; AGE, 52; MEDICAL NO., 121133; DIAGNOSIS, BANTI'S DISEASE; TRANSFUSION, 400 C. C. (1ST TRANSFUSION, 500 C. C.) (SAME DONOR AS 1ST)

Date	11-22-17	11-22-17	11-22-17	11-22-17	11-23-17	Remarks
Time	Before Transfusion 10.40 a. m.	After Transfusion 11.45 a. m.	1.45 p. m.	5.45 p. m.	10.40 a. m.	
	I	II	III	IV	V	
P. M. N.	205 68.3%	193 64.3%	217 72.3%	249 83.0%	258 86.0%	
P. M. E.	5 1.66%	6 2.0%	15 5.0%	9 3.0%	7 2.33%	
P. M. B.	7 2.33%	9 3.0%	8 2.66%	7 2.33%	9 3.0%	
L. Lym.	7 2.33%	8 2.66%	5 1.66%	4 1.33%	0 0	
S. Lym.	19 6.33%	25 8.33%	12 4.0%	12 4.0%	3 1.0%	
L. Mono.	8 2.66%	4 1.33%	5 1.66%	2 0.66%	1 0.33%	
Transitional	13 4.33%	17 5.66%	18 6.0%	13 4.33%	14 4.66%	
N. Myelocytes	1 0.33%	.. ..	.. ..	.. ..	.. ..	
E. Myelocytes	.. ..	.. ..	.. ..	.. ..	.. ..	
B. Myelocytes	.. ..	.. ..	.. ..	.. ..	.. ..	
Myeloblasts	.. ..	.. ..	.. ..	.. ..	.. ..	
Smudges	35 11.6%	38 12.6%	20 6.66%	4 1.33%	8 2.66%	
Platelets	Increased, large in size.	Increased; large in size.	Increased; markedly enlarged in size.	Greatly increased.	.. ..	
Nucleated R. B. C.	0 0	0 0	0 0	0 0	.. ..	
Basophilia	Diffused. Anisocytosis. Poikilocytosis.	Diffused. Marked anisocytosis. Marked poikilocytosis.	Diffused. Marked anisocytosis. Marked poikilocytosis.	Diffused. Anisocytosis. Poikilocytosis.	.. ..	
No. Cells Counted and %.	300 99.87	300 99.88	300 99.94	300 98.65	300 99.98	
Hb.	31%	38%	40%	39%	38%	
R. B. C.	3,488,000	3,384,000	3,552,000	3,496,000	4,352,000	
W. B. C.	11,560	11,360	10,360	10,600	10,049	
C. I.	0.45	0.57	0.57	0.57	0.44	
Condition of Patient	Good; no fever; no chill.	No chill; no fever.	Slight fever.	Slight fever.	No chill; no fever.	
Blood Obtained	Little finger right hand.	Third finger right hand.	Little finger right hand.	Third finger right hand.	Little finger right hand.	Blood transfused in left arm, rapidly.

BLOOD CHART—CASE 9

PATIENT'S NAME, THOMAS HOPKINS; WARD M; AGE, 52; MEDICAL NO., 121133; DIAGNOSIS, BANTI'S DISEASE (?); TRANSFUSION, 500 C. C.

Date	11-9-17	11-9-17	11-9-17	11-9-17	11-10-17	Remarks
Time	Before Transfusion 11.20 a. m.	After Transfusion 1.35 p. m.	2.35 p. m.	5.35 p. m.	11.20 a. m.	
	I	II	III	IV	V	
P. M. N.	230 76.6%	220 73.3%	244 81.3%	228 76.0%	178 59.3%	These cells in slide V were mostly young P. M. with 2 nuclei. Metamyelocytes.
P. M. E.	9 3.0%	8 2.66%	7 2.33%	5 1.66%	26 8.66%	
P. M. B.	4 1.33%	6 2.0%	5 1.66%	7 2.33%	2 0.66%	
L. Lym.	7 2.33%	8 2.66%	4 1.33%	9 3.00%	7 2.33%	
S. Lym.	26 8.66%	17 5.66%	5 1.66%	11 3.66%	26 8.66%	
L. Mono.	2 0.66%	8 2.66%	15 5.0%	4 1.33%	5 1.66%	
Transitional	22 7.33%	19 6.33%	3 1.0%	9 3.0%	23 7.66%	
N. Myelocytes	.. ..	.. ..	.. ..	.. ..	.. ..	These cells were seen in slide II.
E. Myelocytes	.. ..	.. ..	.. ..	.. ..	.. ..	
B. Myelocytes	.. ..	.. ..	.. ..	.. ..	.. ..	Classified under Trans.
Myeloblasts	.. ..	.. ..	.. ..	.. ..	.. ..	
Smudges	0 0	14 4.66%	17 5.66%	27 9.0%	33 11.0%	Seen in slide IV. Classified under Trans.
Platelets	Increased markedly. Large in size.	Increased markedly. Large in size.	Increased markedly. Large in size.	Increased greatly. Large in size.	Increased. Large in size.	
Nucleated R. B. C.	2—Normoblasts, 2 Macrocytes and microcytes.	4—Normoblasts, 2 Microblasts, 2 Macrocytes and microcytes.	4—Normoblasts, 4 Macrocytes and microcytes.	2—Normoblasts, 2 Macrocytes and microcytes.	0 0 Macrocytes and microcytes.	
Basophilia	Diffused. Marked anisocytosis. Marked poikilocytosis.	Diffused. Marked anisocytosis. Marked poikilocytosis.	Diffused. Marked anisocytosis. Marked poikilocytosis.	Diffused. Marked anisocytosis. Marked poikilocytosis.	Diffused. Marked anisocytosis. Marked poikilocytosis.	
No. Cells Counted and %.	300 99.81	300 99.93	300 99.94	300 99.96	300 99.93	
Hb.	18%	23%	23%	24%	22%	
R. B. C.	2,860,000	2,688,000	2,880,000	3,416,000	2,840,000	
W. B. C.	6,940	7,000	7,000	8,120	6,000	
C. I.	.32	.44	.41	.35	.39	
Condition of Patient	Good; no fever; no chill.	No chill; no fever.	Slight fever.	Slight fever.	No chill; no fever.	Pt. had no reaction after transfusion except fever of 100°.
Blood Obtained	Little finger right hand.	Little finger right hand.	Little finger right hand.	Third finger right hand.	Little finger right hand.	Blood transfused in left arm, rapidly.

BLOOD CHART—CASE 10

PATIENT'S NAME, PETER SKAFIDOS; WARD F; AGE, 24; MEDICAL NO., 120804; DIAGNOSIS, ECHINOCOCCUS CYST OF RIGHT LUNG; TRANSFUSION, 500 C. C.

Date / Time	10-25-17 Before Transfusion 2.45 p. m. I		10-25-17 After Transfusion 3.15 p. m. II		10-25-17 5.30 p. m. III		10-25-17 Before Operation 8.15 p. m. IV		10-26-17 After Operation (18 hrs.) 3.30 p. m. V		Remarks
P. M. N.	228	76.0%	227	75.6%	246	82.0%	247	82.3%	251	83.6%	Pt. died from hemorrhage on 10-31-17.
P. M. E.	5	1.66%	1	0.33%	1	0.33%	0	0	0	0	
P. M. B.	2	0.66%	2	0.66%	1	0.33%	3	1.0%	2	0.66%	
L. Lym.	8	2.66%	14	4.66%	10	3.33%	5	1.66%	5	1.66%	
S. Lym.	27	9.0%	16	5.33%	18	6.0%	19	6.33%	9	3.0%	
L. Mono.	5	1.66%	3	1.0%	6	2.0%	6	2.0%	6	2.0%	
Transitional	17	5.66%	17	5.66%	9	3.0%	14	4.66%	16	5.33%	Cell seen in slide III classified here.
N. Myelocytes	..	..	..	..	..	..	..	..	..	..	
E. Myelocytes	..	..	..	..	..	..	..	..	..	..	
B. Myelocytes	..	..	..	..	..	..	..	..	..	..	
Myeloblasts	..	..	..	..	..	..	..	..	..	..	
Smudges	8	2.66%	20	6.66%	9	3.0%	6	2.0%	11	3.66%	
Platelets	Normal.		Normal.		Increased.		Increased slightly.		Increased slightly.		
Nucleated R. B. C.	0	0	0	0	0	0	0	0	2—Normoblasts, 2		
Basophilia	Diffused very little.		Diffused very little.		Diffused very little.		Diffused very little.		Diffused very little.		
No. Cells Counted and %.	300	99.96	300	99.90	300	99.99	300	99.95	300	99.91	
Hb.	25%		35%		35%		33%		32%		
R. B. C.	1,856,000		2,184,000		2,496,000		2,160,000		2,776,000		
W. B. C.	10,560		12,640		13,080		14,800		20,120		
C. I.	.69		.83		.73		.78		.59		
Condition of Patient	Small hemoptysis and blood-streaked sputum.		Small hemoptysis and blood-streaked sputum.		Small hemoptysis and blood-streaked sputum.		Small hemoptysis and blood-streaked sputum.		Fever. Some "old" blood-streaked sputum.		
Blood Obtained	Little finger right hand.		Third finger right hand.		Little finger right hand.		Third finger right hand.		Little finger right hand.		Blood transfused in left arm, somewhat rapidly.

BLOOD CHART—CASE 11

PATIENT'S NAME, SYLVIA MCMILLIAN; WARD O; AGE, 26; GYN. NO., 122424; DIAGNOSIS, POST-OPERATIVE; TRANSFUSION, 300 C. C.

Date / Time	1-13-18 Before Transfusion 10.00 a. m. I		1-13-18 After Transfusion 1.00 p. m. II		1-13-18 3.00 p. m. III		IV	V	Remarks
P. M. N.	227	75.0%	126	42.0%	210	70.0%			To give transfusion rt. arm was used and had to cut down on vein. Patient died at 4.00 p. m.
P. M. E.	1	0.33%	0	0	0	0			
P. M. B.	0	0	0	0	0	0			
L. Lym.	0	0	3	1.0%	3	1.0%			
S. Lym.	29	9.66%	84	28.0%	42	14.0%			
L. Mono.	2	0.66%	6	2.0%	3	1.0%			
Transitional	12	4.0%	15	5.0%	6	2.0%			
N. Myelocytes	6	2.0%	42	14.0%	30	10.0%			
E. Myelocytes	0	0	0	0	0	0			
B. Myelocytes	1	0.33%	0	0	0	0			
Myeloblasts	0	0	3	1.0%	3	1.0%			
Smudges	22	7.33%	21	7.0%	3	1.0%			
Platelets	Practically absent.		Practically absent.		Moderately diminished.				
Nucleated R. B. C.	144—Normoblast, 144		1329—Normoblasts, 1000 Intermediate, 329		849—Normoblasts, 809 Intermediates, 40				
Basophilia	Markedly diffuse; slightly punctate. Moderate anisocytosis. Moderate poikilocytosis.		Markedly diffuse; slightly punctate. Moderate anisocytosis. Moderate poikilocytosis.		Markedly diffused; slight punctate. Moderate anisocytosis. Moderate poikilocytosis.				
No. Cells Counted and %.	300	99.91	300	100.0	300	100.0			
Hb.	5%		22%		19%				
R. B. C.	1,112,000		1,216,000		2,480,000				
W. B. C.	37,700		26,360		24,500				
C. I.	0.22		0.91		0.39				
Condition of Patient	Fever.		Fever.		Fever.				
Blood Obtained	Little finger left hand.		Third finger left hand.		Little finger left hand.				

BLOOD CHART—CASE 12

PATIENT'S NAME, CHARLES THOMAS; WARD D; AGE, 43; SURGICAL NO., 121146; DIAGNOSIS, SINUS TRACT IN OLD WOUND; TRANSFUSION, 500 C. C.

Date / Time	11-25-17 Before Transfusion 12.00 m. I		11-25-17 After Transfusion 2.00 p. m. II		11-25-17 4.00 p. m. III		11-25-17 7.00 p. m. IV		11-26-17 12.15 p. m. V		Remarks
P. M. N.	258	86.0%	253	84.3%	250	83.3%	250	83.3%	242	80.6%	Pt. was operated on Sept. 20, 1917, for gastric ulcer. 50 c. c. blood injected when needle became clogged; interval of half hour before continuing.
P. M. E.	0	0	0	0	0	0	0	0	0	0	
P. M. B.	0	0	0	0	2	0.66%	0	0	1	0.33%	
L. Lym.	3	1.0%	1	0.33%	2	0.66%	5	1.66%	7	2.33%	
S. Lym.	14	4.66%	10	3.33%	12	4.0%	16	5.33%	9	3.0%	
L. Mono.	2	0.66%	1	0.33%	0	0	3	1.0%	2	0.66%	
Transitional	9	3.0%	4	1.33%	4	1.33%	6	2.0%	11	3.66%	
N. Myelocytes	..	..	..	..	..	..	..	..	..	..	Seen in slide I.
E. Myelocytes	..	..	..	..	..	..	..	..	..	..	Classified under Trans.
B. Myelocytes	..	..	..	..	..	..	..	..	..	..	Pt. was operated on again on Nov. 28, 1917. Found tubercles throughout abdominal cavity. Pt. died on Nov. 29, 1917.
Myeloblasts	..	..	..	..	..	..	..	..	..	..	
Smudges	14	4.66%	31	10.3%	30	10.0%	20	6.66%	28	9.33%	
Platelets	Normal.		Slightly increased.		Slightly increased.		Greatly increased.		Greatly increased.		
Nucleated R. B. C.	Slight anisocytosis. Slight poikilocytosis.		Slight anisocytosis. Slight poikilocytosis.		Slight anisocytosis. Slight poikilocytosis.		Slight anisocytosis. Slight poikilocytosis.		Slight anisocytosis. Slight poikilocytosis.		
Basophilia	0	0	0	0	Diffused.		0	0	0	0	
No. Cells Counted and %.	300	99.88	300	99.92	300	99.95	300	99.95	300	99.91	
Hb.	42%		53%		52%		53%		52%		
R. B. C.	3,144,000		3,296,000		3,696,000		3,656,000		4,288,000		
W. B. C.	17,280		14,640		12,160		14,500		11,520		
C. I.	0.67		0.82		0.72		0.73		0.61		
Condition of Patient	No chill; no fever.		Slight chill.		No chill; no fever.		No chill; no fever.		No chill; no fever.		
Blood Obtained	Little finger right hand.		Third finger right hand.		Little finger right hand.		Third finger right hand.		Little finger right hand.		Blood transfused in left arm, slowly.

BLOOD CHART—CASE 13

PATIENT'S NAME, M. STRUZYKOWSKI; WARD G; AGE, 14; MEDICAL NO., 120599; DIAGNOSIS, TYPHOID FEVER; TRANSFUSION, 300 C. C. (10-8-17 1ST TRANSFUSION, 400 C. C.)

Date	10-11-17		10-11-17		10-11-17		10-11-17		10-12-17		Remarks
Time	Before Transfusion 12 m.		After Transfusion 1.50 p. m.		3.15 p. m.		6.15 p. m.		11.15 p. m.		
	I		II		III		IV		V		
P. M. N.	138	46.0%	167	55.6%	195	65.0%	178	59.3%	186	62.0%	
P. M. E.	4	1.33%	0	0	2	0.66%	1	0.33%	1	0.33%	
P. M. B.	0	0	0	0	0	0	0	0	0	0	
L. Lym.	56	18.6%	31	10.3%	34	11.3%	22	7.33%	35	11.6%	
S. Lym.	70	23.3%	65	21.6%	47	15.6%	76	25.3%	54	18.0%	
L. Mono.	2	0.66%	5	1.66%	7	2.33%	7	2.33%	7	2.33%	
Transitional	17	5.66%	7	2.33%	7	2.33%	10	3.33%	13	4.33%	
N. Myelocytes	..	..	..	..	..	..	..	..	..	..	
E. Myelocytes	..	..	..	..	..	..	..	..	..	..	
B. Myelocytes	..	..	..	..	..	..	..	..	..	..	
Myeloblasts	..	..	..	..	..	..	..	..	..	..	
Smudges	13	4.33%	25	8.33%	8	2.66%	6	2.0%	4	1.33%	
Platelets	Decreased slightly; large in size.		Normal; large.		Decreased; large in size.		Large in size.		Decreased; large in size.		
Nucleated R. B. C.	0	0	0	0	0	0	0	0	0	0	
Basophilia	Diffused. Anisocytosis. Poikilocytosis.		Diffused. Slight anisocytosis. Slight poikilocytosis.		Diffused. Slight anisocytosis. Slight poikilocytosis.		Diffused. Slight anisocytosis. Slight poikilocytosis.		Diffused. Slight anisocytosis. Slight poikilocytosis.		
No. Cells Counted and %.	300	99.88	300	99.82	300	99.88	300	99.87	300	99.32	
Hb.	33%		38%		39%		40%		42%		
R. B. C.	1,872,000		1,608,000		2,168,000		2,376,000		2,352,000		
W. B. C.	2,320		3,700		5,200		3,640		3,240		
C. I.	0.91		1.2		0.93		0.87		0.91		
Condition of Patient	Slight fever.		Slight fever.		Slight fever.		Fever.		Slight fever.		
Blood Obtained	Little finger left hand.		Third finger left hand.		Third finger left hand.		Second finger left hand.		Third finger left hand.		Blood transfused in left arm, very slowly.

BLOOD CHART—CASE 14

PATIENT'S NAME, MARIE ZAHRODKA; WARD G; AGE, 29; MEDICAL NO., 120464; DIAGNOSIS, TYPHOID FEVER; TRANSFUSION, 250 C. C.

Date	10-10-17		10-10-17		10-10-17		10-10-17		10-11-17		Remarks
Time	Before Transfusion 11.00 a. m.		After Transfusion 12.05 p. m.		2.05 p. m.		5.30 p. m.		11.30 a. m.		
	I		II		III		IV		V		
P. M. N.	98	32.6%	150	50.0%	154	51.3%	162	54.0%	132	44.0%	
P. M. E.	2	0.6%	1	0.33%	0	0	0	0	0	0	
P. M. B.	0	0	0	0	1	0.33%	0	0	0	0	
L. Lym.	46	15.3%	40	13.3%	62	20.6%	71	23.6%	100	33.3%	
S. Lym.	122	40.6%	66	22.0%	36	12.0%	30	10.0%	31	10.3%	
L. Mono.	5	1.6%	2	0.66%	3	1.0%	2	0.66%	7	2.3%	
Transitional	15	5.0%	29	9.6%	29	9.6%	21	7.0%	28	9.3%	
N. Myelocytes	..	..	..	..	..	..	..	..	..	..	
E. Myelocytes	..	..	..	..	..	..	..	..	..	..	
B. Myelocytes	..	..	..	..	..	..	..	..	..	..	
Myeloblasts	..	..	..	..	..	..	..	..	..	..	
Smudges	12	4.0%	12	4.0%	15	5.0%	14	4.6%	2	0.66%	
Platelets	Large in size; decreased.		Large in size; decreased.		Large in size; decreased.		Large in size; decreased.		Slightly increased.		
Nucleated R. B. C.	None.		None.		None.		None.		None.		
Basophilia	Diffused and punctate. Many cells seen.		Slight anisocytosis. Slight poikilocytosis. Diffused. Many cells seen.		Slight anisocytosis. Slight poikilocytosis. Diffused; very few.		Slight anisocytosis. Slight poikilocytosis. Diffused and punctate; few.		Slight anisocytosis. Slight poikilocytosis. Diffused; few.		
No. Cells Counted and %.	300	99.7	300	99.89	300	99.83	300	99.86	300	99.86	
Hb.	30%		38%		40%		39%		38%		
R. B. C.	2,128,000		1,768,000		1,648,000		1,872,000		2,384,000		
W. B. C.	5,360		7,440		5,120		5,560		5,380		
C. I.	0.71		1.1		1.2		1.0		0.82		
Condition of Patient	Slight chill.		Chill.		Fever.		Fever.		Slight fever.		
Blood Obtained	Little finger right hand.		Third finger right hand.		Third finger right hand.		Little finger right hand.		Little finger right hand.		Blood transfused in left arm—rapidly.

BLOOD CHART—CASE 15

PATIENT'S NAME, BAUER; WARD G; AGE, 28; MEDICAL NO., 125383; DIAGNOSIS, BENZOL POISONING; TRANSFUSION, 600 C. C.

Date	5-20-18		5-20-18		5-20-18		5-20-18		5-21-18		Remarks
Time	Before Transfusion 3.15 p. m.		After Transfusion 4.10 p. m.		6.10 p. m.		9.10 p. m.		3.15 p. m.		
	I		II		III		IV		V		
P. M. N.	50	16.6%	62	20.6%	95	31.6%	62	20.6%	47	15.6%	
P. M. E.	2	0.66%	0	0	2	0.66%	0	0	3	1.0%	
P. M. B.	0	0	0	0	0	0	0	0	0	0	
L. Lym.	4	1.33%	8	2.66%	0	0	5	1.66%	7	2.33%	
S. Lym.	230	76.6%	192	64.0%	187	62.3%	220	73.3%	218	72.6%	
L. Mono.	3	1.0%	20	6.66%	10	3.33%	4	1.33%	10	3.33%	
Transitional	5	1.66%	10	3.33%	0	0	4	1.33%	9	3.0%	
N. Myelocytes	0	0	0	0	0	0	0	0	2	0.66%	
E. Myelocytes	1	0.33%	0	0	0	0	0	0	0	0	
B. Myelocytes	0	0	0	0	0	0	0	0	0	0	
Myeloblasts	2	0.66%	2	0.66%	2	0.66%	3	1.0%	1	0.33%	
Smudges	3	1.0%	6	2.0%	4	1.32%	2	0.66%	3	1.0%	
Platelets	Practically absent. Slight anisocytosis. Slight poikilocytosis.		Practically absent. Slight anisocytosis. Slight poikilocytosis.		Practically absent. Slight anisocytosis. Slight poikilocytosis.		Practically absent. Slight anisocytosis. Slight poikilocytosis.		Practically absent. Slight anisocytosis. Slight poikilocytosis.		
Nucleated R. B. C.	2—Normoblast, 1 Megaloblast, 1		0	0	0	0	2—Normoblasts.		0	0	
Basophilia	Slightly diffused and punctate.		Slightly diffused and punctate.		Slightly diffused and punctate.		Slightly diffused and punctate.		Slightly diffused and punctate.		
No. Cells Counted and %.	300	99.94	300	99.91	300	99.98	300	99.98	300	99.95	
Hb.	38%		43%		47%		45%		45%		
R. B. C.	1,984,000		1,768,000		2,240,000		2,796,000		2,376,000		
W. B. C.	1,160		2,640		1,320		1,280		2,000		
C. I.	1.0		1.2		1.0		0.83		0.95		
Condition of Patient	No chill; no fever.		No chill; no fever.		Slight fever.		Slight fever.		No chill; no fever.		
Blood Obtained	Little finger left hand.		Third finger left hand.		Little finger left hand.		Third finger left hand.		Little finger left hand.		Pt. transfused slowly in right arm.

BLOOD CHART—CASE 16

PATIENT'S NAME, CHAS. WEBER; WARD F; AGE, 17; MEDICAL NO., 122256; DIAGNOSIS, BENZOL POISONING; TRANSFUSION, 275 C. C.

Date	1-11-18		1-1-18		1-1-18		1-1-18		1-2-18		Remarks
Time	Before Transfusion 10.00 a. m.		After Transfusion 11.30 a. m.		1.30 p. m.		4.30 p. m.		11.30 a. m.		
	I		II		III		IV		V		
P. M. N.	121	40.3%	143	47.6%	166	55.3%	138	46.0%	119	39.6%	
P. M. E.	6	2.0%	6	2.0%	8	2.66%	4	1.33%	5	1.66%	
P. M. B.	0	0	0	0	0	0	0	0	0	0	
L. Lym.	60	20.0%	47	15.6%	28	9.33%	7	2.33%	20	6.66%	
S. Lym.	68	22.6%	71	23.6%	86	28.6%	131	43.6%	128	42.6%	
L. Mono.	3	1.0%	4	1.33%	0	0	6	2.0%	5	1.66%	
Transitional	31	10.3%	23	7.66%	8	2.66%	8	2.66%	21	7.0%	
N. Myelocytes	..	..	..	..	..	..	..	..	..	..	
E. Myelocytes	..	..	..	..	..	..	..	..	..	..	
B. Myelocytes	..	..	..	..	..	..	..	..	..	..	
Myeloblasts	..	..	..	..	..	..	..	..	..	..	
Smudges	11	3.66%	6	2.0%	4	1.33%	6	2.0%	2	0.66%	
Platelets	Practically absent.		Practically absent.		Practically absent.		Practically absent.		Practically absent.		
Nucleated R. B. C.	0	0	0	0	0	0	0	0	300	99.84	
Basophilia	Slightly diffused. Slight anisocytosis. Slight poikilocytosis.		Slightly diffused. Slight anisocytosis. Slight poikilocytosis.		Slightly diffused. Slight anisocytosis. Slight poikilocytosis.		Slightly diffused. Slight anisocytosis. Slight poikilocytosis.		Slightly diffused. Slight anisocytosis. Slight poikilocytosis.		
No. Cells Counted and %.	300	99.86	300	99.79	300	99.88	300	99.92	0	0	
Hb.	54%		59%		57%		57%		54%		
R. B. C.	2,648,000		2,272,000		2,512,000		3,216,000		2,368,000		
W. B. C.	2,400		3,160		1,880		1,800		1,720		
C. I.	1.03		1.3		1.9		0.89		1.1		
Condition of Patient	No chill; no fever.		No chill; no fever.		Slight fever.		Slight fever.		No chill; no fever.		
Blood Obtained	Little finger right hand.		Third finger right hand.		Little finger right hand.		Third finger right hand.		Little finger right hand.		Blood transfused in left arm slowly.

BLOOD CHART—CASE 17

PATIENT'S NAME, CHAS. WEBER; WARD F; AGE, 17; MEDICAL NO., 122256; DIAGNOSIS, BENZOL POISONING; THIRD TRANSFUSION, 300 C. C.

Date	1-9-18		1-9-18		1-9-18		1-9-18		1-10-18		Remarks
Time	Before Transfusion 2.00 p. m.		After Transfusion 4.00 p. m.		6.00 p. m.		9.00 p. m.		2.00 p. m.		
	I		II		III		IV		V		
P. M. N.	96	32.0%	110	36.6%	111	37.0%	90	30.0%	90	30.0%	
P. M. E.	1	0.33%	1	0.33%	1	0.33%	1	0.33%	3	1.0%	
P. M. B.	0	0	0	0	0	0	0	0	1	0.33%	
L. Lym.	32	10.6%	18	6.0%	11	3.66%	13	4.33%	17	5.66%	Many patho. lym. in I, II, V.
S. Lym.	115	38.3%	129	43.0%	127	42.3%	162	54.0%	130	43.3%	
L. Mono.	16	5.33%	7	2.33%	11	3.66%	8	2.66%	14	4.66%	
Transitional	28	9.33%	28	9.33%	23	7.66%	18	6.0%	37	12.3%	
N. Myelocytes	1	0.33%	0	0	5	1.66%	1	0.33%	1	0.33%	
E. Myelocytes	0	0	0	0	0	0	1	0.33%	0	0	
B. Myelocytes	0	0	0	0	0	0	0	0	0	0	
Myeloblasts	0	0	1	0.33%	0	0	0	0	0	0	
Smudges	11	3.66%	6	2.0%	11	3.66%	6	2.0%	7	2.33%	
Platelets	Practically absent; those seen large in size.		Practically absent; those seen large in size.		Practically absent; those seen large in size.		Practically absent.		Practically absent.		
Nucleated R. B. C.	0	0	0	0	0	0	0	0	1—Normoblast.		
Basophilia	Moderately diffused. Slight anisocytosis. Slight poikilocytosis.		Moderately diffused. Slight anisocytosis. Slight poikilocytosis.		Moderately diffused. Slight anisocytosis. Slight poikilocytosis.		Moderately diffused. Slight anisocytosis. Slight poikilocytosis.		Moderately diffused. Slight anisocytosis. Slight poikilocytosis.		
No. Cells Counted and %.	300	99.88	300	99.92	300	99.93	300	99.98	300	99.91	
Hb.	39%		42%		43%		40%		41%		
R. B. C.	2,232,000		2,704,000		2,752,000		2,120,000		2,296,000		
W. B. C.	1,920		2,680		2,080		1,880		1,840		
C. I.	0.88		0.77		0.79		0.90		0.93		
Condition of Patient	No chill; no fever.		No chill; no fever.		Slight chill; slight fever.		Slight fever.		No chill; no fever.		
Blood Obtained	Little finger right hand.		Third finger right hand.		Little finger right hand.		Third finger right hand.		Little finger right hand.		Blood transfused in left arm slowly.

BLOOD CHART—CASE 18

PATIENT'S NAME, ELLEN FOPPINO; WARD G; AGE, 36; MEDICAL NO., 125109; DIAGNOSIS, BENZOL POISONING; TRANSFUSION, 750 C. C.

Date	5-11-18		5-11-18		5-11-18		5-11-18		5-12-18		Remarks
Time	Before Transfusion 2.00 p. m.		After Transfusion 3.45 p. m.		5.45 p. m.		8.45 p. m.		2.00 p. m.		
	I		II		III		IV		V		
P. M. N.	11	3.66%	14	4.66%	35	11.6%	9	3.0%	11	3.66%	
P. M. E.	0	0	2	0.66%	0	0	0	0	0	0	
P. M. B.	0	0	0	0	0	0	0	0	0	0	
L. Lym.	108	36.0%	48	16.0%	13	4.33%	16	5.33%	12	4.0%	
S. Lym.	169	56.3%	223	74.3%	252	84.0%	270	90.0%	277	92.3%	
L. Mono.	12	4.0%	9	3.0%	0	0	0	0	0	0	
Transitional	0	0	2	0.66%	0	0	0	0	0	0	
N. Myelocytes	0	0	0	0	0	0	0	0	0	0	
E. Myelocytes	0	0	0	0	0	0	0	0	0	0	
B. Myelocytes	0	0	0	0	0	0	0	0	0	0	
Myeloblasts	0	0	2	0.66%	0	0	5	1.66%	0	0	
Smudges	0	0	0	0	0	0	0	0	0	0	
Platelets	Practically absent.		Occasional; those seen large in size, bizarre in shape.		Practically absent.		Practically absent.		Practically absent.		
Nucleated R. B. C.	0	0	0	0	0	0	1—Megaloblast.		0	0	
Basophilia	Moderate anisocytosis. Moderate poikilocytosis. Slightly diffused.		Moderate anisocytosis. Moderate poikilocytosis. Slightly diffused.		Moderate anisocytosis. Moderate poikilocytosis. Slightly diffused.		Moderate anisocytosis. Moderate poikilocytosis. Slightly diffused.		Moderate anisocytosis. Moderate poikilocytosis. Slightly diffused.		
No. Cells Counted and %.	300	99.96	300	99.94	300	99.93	300	99.99	300	99.96	
Hb.	35%		40%		44%		45%		40%		
R. B. C.	2,048,000		2,856,000		2,432,000		2,464,000		2,616,000		
W. B. C.	600		640		800		800		280		
C. I.	.87		.82		.91		.93		.76		
Condition of Patient	..	..	..	..	..	..	..	..	..	..	
Blood Obtained	Little finger left hand.		Third finger left hand.		Little finger left hand.		Third finger left hand.		Little finger left hand.		Pt. transfused slowly in right arm.

BLOOD CHART—CASE 19

PATIENT'S NAME, STROMBERGER; WARD G; AGE, 19; MEDICAL NO., 126431; DIAGNOSIS, IDIOPATHIC PURPURA; TRANSFUSION, 700 C. C.

Date	5-12-18	5-12-18	5-12-18	5-12-18	5-13-18	Remarks
Time	Before Transfusion 2.00 p. m.	After Transfusion 3.10 p. m.	5.10 p. m.	8.10 p. m.	2.00 p. m.	
	I	II	III	IV	V	
P. M. N.	247 82.3%	233 77.6%	234 78.0%	230 76.6%	237 79.0%	
P. M. E.	6 2.0%	6 2.0%	4 1.33%	7 2.33%	4 1.33%	
P. M. B.	1 0.33%	2 0.66%	2 0.66%	2 0.66%	1 0.33%	
L. Lym.	0 0	2 0.66%	0 0	0 0	0 0	
S. Lym.	30 10.0%	30 10.0%	43 14.3%	30 10.0%	41 13.6%	
L. Mono.	4 1.33%	13 4.33%	7 2.33%	14 4.66%	9 3.0%	
Transitional	8 2.66%	6 2.0%	6 2.0%	12 4.0%	5 1.66%	
N. Myelocytes	0 0	0 0	3 1.0%	0 0	0 0	
E. Myelocytes	0 0	0 0	0 0	0 0	0 0	
B. Myelocytes	0 0	0 0	0 0	0 0	0 0	
Myeloblasts	1 0.33%	1 0.33%	0 0	1 0.33%	1 0.33%	
Smudges	3 1.0%	8 2.66%	1 0.33%	4 1.33%	2 0.66%	
Platelets	Practically absent.	Practically absent.	Practically absent.	Practically absent.	Practically absent.	
Nucleated R. B. C.	0 0	0 0	0 0	0 0	0 0	
	Slight anisocytosis. No poikilocytosis.	Slight anisocytosis. No poikilocytosis.	Slight anisocytosis. No poikilocytosis.	Slight anisocytosis. No poikilocytosis.	Slight anisocytosis. No poikilocytosis.	
Basophilia	0 0	0 0	0 0	0 0	0 0	
No. Cells Counted and %.	300 99.95	300 99.94	300 99.95	300 99.91	300 99.91	
Hb.	73%	81%	85%	84%	81%	
R. B. C.	5,014,000	5,120,000	5,132,000	5,616,000	5,474,000	
W. B. C.	8,200	12,500	12,600	13,400	14,200	
C. I.	0.73	0.78	0.83	0.75	0.74	
Condition of Patient	No chill; no fever.	No chill; no fever.	Slight fever.	Slight fever.	No chill; no fever.	
Blood Obtained	Little finger right hand.	Third finger right hand.	Little finger right hand.	Third finger right hand.	Little finger right hand.	Pt. transfused slowly in left arm.

BLOOD CHART—CASE 20

PATIENT'S NAME, MARY STROMBERGER; WARD G; AGE, 19; MEDICAL NO., 126431; DIAGNOSIS, IDIOPATHIC PURPURA; 1ST TRANSFUSION, 600 C. C.

Date	4-29-18	4-29-18	4-29-18	4-29-18	4-30-18	Remarks
Time	Before Transfusion 12.30 p. m.	After Transfusion 1.55 p. m.	3.55 p. m.	6.55 p. m.	12.30 p. m.	
	I	II	III	IV	V	
P. M. N.	196 65.3%	197 65.6%	255 85.0%	249 83.0%	165 55.0%	
P. M. E.	4 1.33%	2 0.66%	1 0.33%	0 0	8 2.66%	
P. M. B.	3 1.0%	2 0.66%	1 0.33%	0 0	4 1.33%	
L. Lym.	4 1.33%	7 2.33%	2 0.66%	1 0.33%	2 0.66%	
S. Lym.	66 22.0%	45 15.0%	20 6.66%	25 8.33%	81 27.0%	Path. Lym. (Reider)
L. Mono.	9 3.0%	8 2.66%	4 1.33%	13 4.33%	13 4.33%	Two seen in I, one seen in V.
Transitional	12 4.0%	17 5.66%	3 1.0%	9 3.0%	17 5.66%	
N. Myelocytes	0 0	0 0	0 0	0 0	0 0	
E. Myelocytes	0 0	0 0	0 0	0 0	0 0	
B. Myelocytes	0 0	0 0	0 0	0 0	0 0	
Myeloblasts	0 0	0 0	0 0	0 0	1 0.33%	
Smudges	6 2.0%	22 7.33%	14 4.66%	3 1.0%	10 3.33%	
Platelets	Practically absent; those seen large in size.	Markedly diminished; those seen large in size and bizarre in shape.	Markedly diminished; Those seen large in size and bizarre in shape.	Practically absent; those seen large in size and bizarre in shape.	Practically absent; those seen large in size.	
Nucleated R. B. C.	3—Normoblast, 3 Marked anisocytosis. Marked poikilocytosis.	0 0	0 0	0 0	0 0 Marked anisocytosis. Marked poikilocytosis.	
Basophilia	Moderately diffused.	Moderately diffused.	Slightly diffused.	Slightly diffused.	Slightly diffused.	
No. Cells Counted and %.	300	300	300	300	300	
Hb.	40%	46%	49%	49%	48%	
R. B. C.	3,492,000	3,900,000	3,904,000	3,912,000	3,888,000	
W. B. C.	7,600	8,100	11,200	11,680	6,500	
C. I.	0.66	0.58	0.62	0.62	0.63	
Condition of Patient	No chill; no fever.	No chill; no fever.	Severe chill.	Fever 103°.	No chill; no fever.	
Blood Obtained	Little finger left hand.	Third finger left hand.	Little finger left hand.	Third finger left hand.	Little finger left hand.	Pt. transfused in left arm very slowly.

BLOOD CHART—CASE 21

PATIENT'S NAME, WILLIAM MEYER; WARD F; AGE, 52; MEDICAL NO., 121243; DIAGNOSIS, HYPERTENSION WITH MYOCARDIAL INSUFFICIENCY; CONTROL; NO TRANSFUSION

Date	11-30-17	11-30-17	11-30-17	12-1-17	Remarks
Time	Before Transfusion 2.20 p. m.	After Transfusion 4.30 p. m.	6.30 p. m.	2.30 p. m.	
	I	II	III	IV	
P. M. N.	212 70.6%	212 70.6%	203 67.6%	212 70.6%	
P. M. E.	1 0.33%	1 0.33%	3 1.0%	2 0.66%	
P. M. B.	0 0	0 0	0 0	1 0.33%	
L. Lym.	10 3.33%	9 3.0%	16 5.33%	11 3.66%	
S. Lym.	51 17.0%	52 17.3%	50 16.6%	51 17.0%	
L. Mono.	5 1.66%	7 2.33%	9 3.0%	7 2.33%	
Transitional	11 3.66%	11 3.66%	8 2.63%	9 3.0%	
N. Myelocytes	.. ..	.. ..	.. ..	.. ..	
E. Myelocytes	.. ..	.. ..	.. ..	.. ..	
B. Myelocytes	.. ..	.. ..	.. ..	.. ..	
Myeloblasts	.. ..	.. ..	.. ..	.. ..	
Smudges	10 3.33%	8 2.66%	11 3.66%	7 2.33%	
Platelets	Normal. No anisocytosis. No poikilocytosis.	Normal. No anisocytosis. No poikilocytosis.	Normal. No anisocytosis. No poikilocytosis.	Normal. No anisocytosis. No poikilocytosis.	
Nucleated R. B. C.	1—Normoblast.	0 0	0 0	0 0	
Basophilia	0 0	0 0	0 0	0 0	
No. Cells Counted and %.	300 99.91	300 99.88	300 99.85	300 99.91	
Hb.	73%	74%	74%	74%	
R. B. C.	4,384,000	4,376,000	4,280,000	4,392,000	
W. B. C.	7,300	7,360	7,400	7,240	
C. I.	0.84	0.86	0.88	0.86	
Condition of Patient	No chill; no fever.	No chill; no fever.	No chill; no fever.	No chill; no fever.	
Blood Obtained	Little finger right hand.	Third finger right hand.	Little finger right hand.	Third finger right hand.	

ELIZABETH FRY—QUAKER REFORMER[1]

By Henry M. Thomas

In speaking of Elizabeth Fry to my friends I am struck with how little is known about her, and yet one hundred years ago she was beginning in London a career that made her the most influential woman of her time, certainly in philanthropy and, I believe, in general.

To understand Elizabeth Fry and her struggles it is necessary to know something about Quakers, or the Society of Friends, to which sect she belonged.

Most of you know that the Society of Friends was founded by George Fox in 1647-48 as a protest against the formality and abuses which he believed had affected the Church at that time. He taught that true religion is a direct personal experience, and that there is in every man's soul something that responds to the truth as revealed in the Bible, which, when properly regarded and attended to, is a safe guide for conduct. This view led to a personal interpretation of the Bible and did away with creeds and the authority of priests or ministers. He and his followers "bore testimony," as they would say, against many customs and beliefs that they disapproved of. They took many of the injunctions of the Bible literally and felt it wrong to call any man master and to show more respect to one than to another, and they therefore refused to take off their hats before the great and keep them on before the lowly, said "thee" and "thou" to their equals and superiors as well as to those usually called inferiors, adopted a manner of dress which they did not change with the fashions, refused to take legal oaths, and many other such things. From the first they acknowledged the complete equality of women and gave them equal influence in the conduct of the Society.

George Fox was a powerful, persuasive preacher, and influenced many people particularly among the lowly, but not a few among the well-to-do and learned. Among these latter were William Penn, Robert Barclay and John Gurney. John Gurney, the ancestor of Elizabeth Fry, was put into prison with other Friends and remained there for three years because he would not take the oath of allegiance, his testimony being against taking any oath. All the Gurneys appear to have been prosperous, and were interested in woolen weaving and in banking.

John Gurney, Elizabeth Fry's father, married Catherine Bell, the great granddaughter of Robert Barclay, the Quaker apologist, and so the Gurneys of Earlham could trace their ancestry on both sides through an unbroken line of influential Quakers to founders of the Society.

John Gurney had inherited quite a large property and had himself prospered. In 1786 he leased from Edward Bacon the estate of Earlham in Norfolk near Norwich, and it is from this estate which stayed in the Gurney family for nearly 100 years that the Gurneys of Earlham took their name.

Augustus Hare's book (The Gurneys of Earlham) is by far the most attractive account of this remarkable family. John Gurney and his wife had 12 children, 11 of whom grew up. Of these 11 there were seven daughters and four sons. Mrs. Gurney died when her youngest child was only a little over a year old, and the eldest, Catherine, who from that time took charge of the family, was only 17. Mr. Gurney and his wife were not strict Quakers, and although they conformed in some respects to the customs of the Society, they were very liberal in their manner of life and I have no doubt were the objects of deep concern to their plainer relatives and other members of the Society.

At the time of Mrs. Gurney's death, Elizabeth, the third daughter, was just 12, having been born on the 21st of May, 1780. There was one sister between Catherine and herself and next to her came a boy, John, then four girls born in three years, and three boys ending the flock. These 11 children, deprived of their mother, were drawn closely together and developed themselves and each other into a wonderfully united family. Catherine, who when still very young, was known as Mrs. Catherine Gurney, felt the chief responsibility of their bringing up, and with the help of the older girls guided them as best she could. The father interfered but little, requiring only that they go to Meeting on First Day at least once and sometimes twice. Even this slight conformity was resented by the young people and many are the disparaging remarks recorded in the journals of the children, for keeping of journals appeared to be one of the methods of education in this family, and, indeed, in general at that period. In "The Gurneys of Earlham" we find interesting abstracts from these journals and I wish that I might read you some of them. Indeed, I must read one note written by Louisa Gurney when 11 years old, particularly as it refers to the subject of our study and gives us a glimpse of one phase of the family.

Aug. 14 (1796). Betsy is so ill, I look forward with the most gloomy ideas concerning her. . . . . A great many Friends came to tea. I did all I could to please them. How charming it is to feel one is giving pleasure: though I can never say how stupid they were to me. . . . . After tea Kitty chose we should work again; this was rather a tug to me, but I bore it pretty well, only Kitty did provoke me by making me give up something to Chenda, merely because she was the eldest; there is nothing I hate so much as this sort of partiality; it does provoke me so. We read a little Sacred History; I like the Old Testament amazingly.

The house at Earlham was very large and the Gurneys entertained freely, and as the girls grew older it must have been a most attractive place to visit. The seven girls dressed as gaily as possible, and were often seen in a band riding

[1] Read before The Johns Hopkins Historical Society, February 12, 1917.

ELIZABETH, MRS. FRY.
After the Portrait by George Richmond.

over the country on their ponies, wearing scarlet riding habits. The literary and scientific young men of the neighborhood came to the house and there was much discussion on the subjects of the day, particularly in relation to the philosophy of Rousseau, Voltaire and other free-thinking authors of those times. Among this group there were only two young men who took a serious view of life—one the Baptist minister, the other a Roman Catholic chemist named Pitchford, and strangely enough it was this latter who was the one steadying influence to this flock of Quakers. Among this band Elizabeth was probably the gayest and in many ways the most attractive. She sang sweetly, danced beautifully, and was a remarkably independent character. From a very early age she appears to have been delicate and to have suffered from marked nervous symptoms. She was dreadfully afraid of many things, particularly of the dark and of the water. She also kept a diary, but, unfortunately, when she read it over towards the end of her life she felt it wise to destroy all the early years. Judging from what she wrote later, it would have been a most valuable account of the feelings and experiences of a nervous child. She herself when 48 recorded her impressions of herself at an early age:

Dagenham, Eighth Month, 23d, 1828. My earliest recollections are, I should think, soon after I was two years old; my father at that time had two houses, one in Norwich, and one at Bramerton, a sweet country place, situated on a Common, near a pretty village; here, I believe, many of my early tastes were formed, though we left it to reside at Earlham, when I was about five years. The impressions then received remain lively on my recollection; the delight in the beauty and wild scenery in parts of the Common, the trees, the flowers, and the little rills, that abounded on it, the farm houses, the village school, and the different poor people and their cottages; particularly a poor woman with one arm, whom we called one-armed Betsy; another neighbor, Greengrass, and her strawberry beds around a little pond; our gardener, who lived near a large piece of water, and used to bring fish from it; here, I think, my love for the country, the beauties of nature, and attention to the poor, began. My mother was most dear to me, and the walks she took with me in the old-fashioned garden, are as fresh with me, as if only just passed; and her telling me about Adam and Eve being driven out of Paradise: I always considered it must be just like our garden at Bramerton. I remember that my spirits were not strong; that I frequently cried if looked at, and used to say that my eyes were weak; but I remember much pleasure and little suffering, or particular tendency to naughtiness, up to this period. Fear about this time began to show itself, of people and things: I remember being so much afraid of a gun, that I gave up an expedition of pleasure with my father and mother, because there was a gun in the carriage. I was also exceedingly afraid of the dark, and suffered so acutely from being left alone without a light after I went to bed, that I believe my nervous system was injured in consequence of it; also, I had so great a dread of bathing (to which I was at times obliged to submit) that at the first sight of the sea, when we were as a family going to stay by it, it would make me cry; indeed, fear was so strong a principle in my mind, as greatly to mar the natural pleasure of childhood. I am now of opinion, that it would have been much more subdued, and great suffering spared, by its having been still more yielded to; by having a light left in my room; not being long left alone; and never forced to bathe; for I do not at all doubt that it partly arose from that nervous susceptible constitution, that has at times, throughout my life, caused me such real and deep suffering. I know not what would have been the consequence, had I had any other than a most careful and wise mother, and judicious nurses, or had I been alarmed, as too many children are, by false threats of what might happen.

Even though treated so carefully by others her vivid imagination tormented her, and her early diaries must have contained many outpourings of her spirit. These are lost and we can only guess their character by her later struggles and the records of her sisters and friends.

John Pitchford records[1] that she told him of being so impressed as a child by the story of Abraham and Isaac that she was afraid to go to Meeting for fear that her parents would be required to sacrifice her.

The state of her health secured her many privileges. She was allowed to sleep later than the other children and was usually excused from going to Meeting on Sundays—a much prized privilege. The meeting house in Norwich was reached through Goat's Lane and the children always spoke of the meeting as "Goat's," and recorded in their journals their feelings with such remarks as "I stayed at home from Goat's which I was most glad of," "A long, dis(disgusting) meeting at Goat's," etc. (Louisa, 11 years.)

Mr. Gurney was "labored with" about his indulgence of Elizabeth, and when she was older he required her to attend Meeting more regularly. There were no paid ministers among the Quakers and they depended for the "spoken word" upon certain of their members feeling called; that is, having a sense that they must either pray or preach. Certain members who spoke frequently and acceptably were acknowledged by the Meeting and designated as ministers, and certain of them traveled from Meeting to Meeting and were called Public Friends or Visiting Friends. It was to hear one of these that Elizabeth Gurney went when she was 17 years old. Her diary, which has been preserved from about this time, reads:

Sunday, Feb. 4th, 1798. This morning I went to Meeting, though but poorly, because I wished to hear an American Friend, named William Savery. Much passed there of a very interesting nature. I have had a faint light spread over my mind, at least I believe it is something of that kind, owing to having been much with, and heard much excellence from, one who appears to me a true Christian. It has caused me to feel a little religion. My imagination has been worked upon, and I fear all that I have felt will go off. I fear it now; though at first I was frightened, that a plain Quaker should have made so deep an impression upon me; but how truly prejudiced in me to think that, because good came from a Quaker, I should be led away by enthusiasm and folly. But I hope I am now free from such fears. I wish the state of enthusiasm may last, for to-day I have felt that there is a God; I have been devotional, and my mind has been led away from the follies that it is mostly wrapped up in. We have had much serious conversation; in short, what he said and what I felt, was like a refreshing shower, falling upon earth, that has been dried up for ages. It has not made me unhappy: I have felt ever since

[1] Augustus Hare: Gurneys of Earlham, Vol. I, p. 47.

humble. I have longed for virtue. I hope to be truly virtuous; to let sophistry fly from my mind; not to be enthusiastic and foolish; but only to be so far religious as will lead to virtue. There seems nothing so little understood as religion.

A most interesting struggle had begun of which I can only give the bare outlines. She records two days following, on the 6th:

My mind has by degrees flown from religion. I rode to Norwich, and had a very serious ride there; but meeting, and being looked at, with apparent admiration, by some officers, brought on vanity; and I came home as full of the world, as I went to town full of heaven.

However defective the education of the Gurney children may have been, it had at least led to a remarkable independence of thought. Of all of them Elizabeth seems to have been the most independent, and she then and all through her life showed a very clear insight into her thoughts and feelings. She records on Sunday, the 11th:

It is very different to this day week (a day never to be forgotten whilst memory lasts). I have been to Meeting this morning To-day I have all my old irreligious feelings: my object shall be to search, try to do right, and if I am mistaken, it is not my fault; but the state I am now in makes it difficult to act. What little religion I have felt has been owing to my giving way quietly and humbly to my feelings; but the more I reason upon it, the more I get into a labyrinth of uncertainty, and my mind is so much inclined to both scepticism and enthusiasm, that if I argue and doubt, I shall be a total sceptic; if, on the contrary, I give way to it, and as it were, wait for religion, I may be led away. But I hope that will not be the case; at all events, religion, true and uncorrupted, is of all comforts the greatest; it is the first stimulus to virtue; it is a support under every affliction. I am sure it is better to be so in an enthusiastic degree, than not to be so at all, for it is a delightful enthusiasm.

There are many other records of the struggle. She was so determined not to be carried away by her emotions that she got her father's consent to send her to London so that she might see for herself the attractions of the world and decide whether she could be content in their enjoyment. While in London she took music and dancing lessons, went to the plays and to the opera, and saw as much of gay society as her opportunities allowed. Her diary for March 26, 1798, reads:

This morning I went to Amelia Opie's and had a pleasant time. I called on Mrs. Siddons, who was not at home; then on Dr. Batty; then on Mrs. Twiss, who gave me some paint for the evening. I was painted a little, I had my hair dressed, and did look pretty for me. Mr. Opie, Amelia, and I, went to the Opera concert. I own, I do love grand company. The Prince of Wales was there; and I must say, I felt more pleasure in looking at him, than in seeing the rest of the company, or hearing the music. I did nothing but admire his Royal Highness; but I had a very pleasant evening indeed.

On the other side, William Savery was also in London and she went to Meeting to hear him preach and had some conversation with him, and when she returned after two months she began to feel pretty sure that she was going to turn into a plain Quaker. She regarded the change with great interest, but with not a little apprehension, as she knew what a trial it would be to her father as well as to the rest of the children.

In May, to distract her mind, her father proposed another visit to London, and she writes in her journal on the 24th:

I wrote to my father this morning. I must be most careful not to be led by others, for I know at this time I have so great a liking for plain Friends, that my affection being so much engaged, my mind may be also by them. I hope as I now find myself in so wavering a state, that I may judge without prejudice of Barclay's Apology.

It was about this time, when she was just 18, that she began her first independent philanthropic venture—the establishment of her school at Earlham for poor children. She had always found it easy to do for others, and even before her religious awakening she had been her father's instrument for the distribution of his charities. She took such a delight in doing for people and giving help that she recognized very clearly that she deserved no great praise for so doing.

Her development into a plain Quaker progressed deliberately and she took no step in that direction without much thought and travail of spirit, but she adopted one peculiarity after another in spite of the open opposition of her immediate family and often against what seemed to her the dictates of reason. She gave up dancing—a pleasure she delighted in—and singing, gradually changed the manner of her dress, and used thee and thou, the so-called singular form.

To counteract all this Mr. Gurney took her with some of the other children on trips, and she seems to have enjoyed what she saw, but the Quakers whom they met at various places interested her more. She on her part was the object of the deepest interest to the Friends, as indeed was natural.

At one time, when 19, she was appointed on a committee to investigate the Ackworth School, and afterwards, when the young people were encouraged to speak and nothing was said, she spoke. Of this she writes: "As it appeared to me it was delaying the meeting I took courage (as I thought it was more right than wrong to speak); and said what I thought of the grammar and ciphering; I felt glad I had done it though I trembled at doing it not a little." She was then asked her opinion of other matters about the school. This seems to have been her first service on a committee of investigation.

During this visit she records on July 4, 1799: "This morning we walked to York and saw its wonders. We saw the Friends' Retreat for crazy people which my father thought extravagantly kept." This institution had been founded in 1792 by Friends, under the guidance of William Tuke, and was the first place in England where the humane treatment of the insane was attempted. I have found no other references to her having visited it again, but she was doubtless quite familiar with the ideas and methods carried out there, as the proper care of the insane was a common subject of discussion in the Society.

In America the Friends had long been interested in the subject. In 1709 the Philadelphia Monthly Meeting took steps towards the establishment of a hospital for the sick and the insane, but it was not until 1751 that the Pennsylvania

hospital was founded. This institution among other sick cared for patients "distempered in mind and deprived of their mental faculties." In 1813 the Philadelphia Friends, stimulated by the success of the York Retreat, founded at Frankford a Friends' Asylum.

Upon returning to Earlham, Elizabeth began to take a more active part in the Meeting, and in the fall of 1799 was appointed a representative. Her Sunday school for children increased rapidly, and here she began to show her remarkable power over audiences. She paid great attention to the manner of reading (for she objected to the way the Bible was usually read), and it must have been here that she began to develop the very remarkable style that was so effective throughout her life.

She was married when just 20 to Joseph Fry, the son of another prominent Quaker family. The Frys were also well-to-do and were in business in London. Unlike the Gurneys, they were the strictest of plain Friends. You well imagine that this important step was not taken without due deliberation. Elizabeth felt that she had a distinct work, and like so many young women of to-day she was loath to give it up. The sisters helped in the decision by filling their diaries with hopes and prayers that Betsy might make no mistake. Joseph Fry's first proposal was refused, but thinking from the tone of a note that he might receive a different answer, he went back to Earlham. Augustus Hare, from whom I quote, gives a most amusing account of the outcome. Joseph Fry did not dare risk a second proposal so "he bought a very handsome gold watch and chain and laid them upon a white seat. . . . . 'If Betsy take up that watch,' he said, 'it is a sign that she accepts me, but if she does not take it up by a particular hour, it will show that I must leave Earlham.' The six sisters concealed themselves in six laurel bushes, in different parts of the grounds, to watch." When Betsy first discovered the watch she retreated to the house, but the sisters kept up their vigil from the laurel bushes. Just where Joseph Fry was the account does not state, but continues: "Once again did the anxious sisters see Betsy emerge from the house, with more faltering steps this time, but still inwardly praying, and slowly, tremblingly, they saw her take up the watch, and the deed was done."

Upon going to London Elizabeth Fry was thrown into quite new surroundings, and it is amusing to find that, although she was considered austere and plain among the Gurneys, among the Frys she was looked upon as far too gay and too much given to worldly customs. Her children came rapidly, and by a most unusual circumstance in exactly the number and order as to sex as her mother's, and as each one came it was given the name of the corresponding Gurney child. Her health was not good, and these first years were largely taken up in adapting herself to her new surroundings. She was always helping those in want when they came to her attention, but took no special part in public charities.

An interesting incident occurred shortly after her first child was born, and we find in her journal (A Memoir of the life of Elizabeth Fry, 1847, Vol. I, p. 108) the following:

Mildred's Court, Eleventh Month, 25th (1801). My cough has been so poorly that my husband called in Dr. Simms. I asked his advice about our little one being inoculated; he strongly recommended the cow-pox, and said that he would undertake the care of her if we liked: I think highly of his judgment, and I believe it to be our duty to avoid evil, both bodily and mentally. So trifling a complaint as the cow-pox, being likely to prevent so dreadful a disease as the small-pox, at least it appears justifiable to try it; although the idea is not pleasant, it almost looks like taking too much on ourselves to give a child a disease. But I altogether was easy to do it. I felt a good deal about the operation, which was very little and easily performed. What a wonderful discovery it is if it really prevents the small-pox.

You may remember that the first vaccination with cow-pox was done by Jenner in 1796, just six years before this incident.

She became an ardent advocate of vaccination, and when, after the death of her father-in-law, in 1811, she moved to the large country place at Plashet, in the parish of East Ham, she herself vaccinated the children of the parish, having been taught the method by Dr. Willan, an early and earnest exponent of the practice. She inspected the children from time to time to see that none were left unvaccinated. In these villages small-pox became practically extinct.

Elizabeth Fry soon became the philanthropic Lady Bountiful of the parish, and there was nothing for the good of the people that she was not busy about. She saw that the sick and injured were visited, established a depot for the distribution of clothing, and in winter she had soup prepared at her house in such quantities as to supply hundreds. With the help of the clergyman and his wife she established a school in which 70 girls were taught.

From the first, after moving to London, Elizabeth Fry was active in the Society of Friends. She spoke more and more frequently in Meeting, and in 1811 her gift was formally acknowledged by the Meeting and she became a recommended minister.

The Frys entertained Friends constantly, and it was not often that they did not have one of Elizabeth Fry's brothers or sisters from Earlham staying with them. After moving to Plashet the household became still more complicated, and there are many notes in her journal telling of the thought that she gave to her household, particularly to the proper treatment of servants.

Her first 10 children were born in 16 years, and the last child six years afterwards, November 1, 1822.

In 1813 she paid her first visit to Newgate Prison where she was much impressed by the misery of the women. There is nothing in her journal, however, that suggests that at that time she felt prison reform to be her great work, and it was not until three years later that she made her second visit, this time at the instigation of two of her brothers-in-law. The condition of this prison was most lamentable and some of the descriptions are hard to believe. Years before John

Howard had called attention to the prisons in England and had had laws passed by Parliament for their betterment, but these laws seem to have been at this time almost completely disregarded. The part of Newgate in which the women were confined was the worst part, and the conditions were those of utter squalor, misery and vice; indeed, they were so terrible that the governor himself went there as rarely as possible, and it had for one of its titles "Hell above ground." All the women were herded together without any attempt at classification. There were many children among them, filthy and half-naked. It was in these discouraging surroundings that Elizabeth Fry and her companion requested to be left alone with the women. I doubt whether upon going there she had any plan formed in her mind, but with her quick instinct she made the one appeal that was most likely to be effective. She spoke to the women of their children and showed them how their behavior was affecting them, and she suggested that, if they would co-operate with her, she would form a class to instruct the children, but that this must be with their co-operation and that they themselves were to select one of their number to be the teacher. The women immediately grasped at the plan and by the next visit they had chosen Mary Connor, a young prostitute convicted for stealing a watch, to be the school-mistress.

It was in these discouraging circumstances that the work began. The prison authorities were entirely skeptical as to the outcome, but allowed Elizabeth Fry and her associates to try it. The plan succeeded from the first and it was not long before numbers of the older women were clamoring to be allowed to attend the classes. Other ladies joined Elizabeth Fry and visited the prison daily, and it then became possible to extend the work to the older women. The women were divided into different groups, a monitor from among their number was chosen for each group, and occupation was provided for them as well as daily Bible readings and other instruction. A matron over the women prisoners was also introduced.

To do all this required a considerable sum of money which was provided by the committee, especially by Elizabeth Fry and her brothers. The visiting committee of ladies became later the British Ladies' Society for Promoting the Reformation of Female Prisoners, with many branches throughout the kingdom.

The changes that followed these reforms on the women's side at Newgate were so marked and occurred so quickly that they attracted widespread attention, and two years after their inception, in 1818, Elizabeth Fry and her brother, Joseph John Gurney, visited many of the prisons in Scotland and the north of England. The notes (Notes on a Visit Made to Some of the Prisons in Scotland and the North of England in Company with Elizabeth Fry, etc., London, 1819) of this visit were published by Mr. Gurney. The state of each prison they visited is recorded and at the end of the book he has brought together their ideas as to prison management. Later, Elizabeth Fry published her views on this subject (Observations on the Visiting, Superintendence, and Government of Female Prisoners, London, 1827), and they can also be learned from the reports of various Parliamentary Commissions before which she gave testimony. In brief, she believed it essential that the women prisoners should be entirely separate from the men prisoners, that they should be under the direct care of only women, and should be visited by the men officers only in the presence of women; that the women prisoners should be classified, the tried from the untried, the more hardened offenders from those less so, etc.; that they should be properly clothed, fed and warmed; that the uniform of each class should be different, and that prisoners should be graded according to behavior. She insisted upon the importance of instruction, particularly religious, and urged that the Bible be read to them daily and that it should always be within easy access. Useful occupation she regarded as of first importance, the occupation being so planned as to bring them some remuneration while in prison and to help them to earn their living when they were released. She did not feel that the lot of the prisoners should be made too easy, but she insisted that the first idea must be that of reformation. Solitary confinement she believed to be open to grave dangers, although she advocated strongly that each prisoner be alone at night. She earnestly opposed capital punishment in general, and especially when it was administered for trifling offences as it was at that time.

The importance of the supervision of prisoners upon their release was also insisted upon, and the ladies of the committee gave special attention to those women who were to be transported to the penal colonies in Australia. The condition of these women had been most deplorable and their residence in the colony a scandal. The committee was instrumental in providing work for the women to do during the voyage, matrons to have charge of them and proper methods for their reception and care upon arrival.

Elizabeth Fry had the great satisfaction of seeing practically all of her suggestions adopted, and it was not long after she had begun her work for the prisoners that to her consternation she found herself famous. Few distinguished people visited London without accompanying her to her class at Newgate. Her advice was asked by very many people; she appeared before committees of Parliament and many Societies. Her influence was little short of marvellous. Correspondence was established with philanthropic persons in various countries in Europe. She gave advice as to the management of prisons and the care of the insane. She had long correspondence with the philanthropic Venning brothers, John and Walter, who were living in St. Petersburg. It was through them that she sent advice as to the improvement of the lunatic asylum at St. Petersburg, in which the Dowager Empress had become interested and which she had taken under her special care. Elizabeth Fry recommended cast-iron window frames instead of the clumsy iron bars which had been used in the old institution. She also recommended that all except the

violent lunatics dine together at a table covered with a cloth and furnished with plates and spoons. Here, as everywhere, she felt the importance of the Bible, and the New Testament was introduced into this institution.

To show how closely Elizabeth Fry's suggestions were followed, I shall quote portions of a letter from Mr. Venning written after her death (Memoir, Vol. 1, p. 387):

When I received a letter from your mother I always wrote it out in French and presented it in that language to the Empress, and when she had read it, it was very encouraging to see with what alacrity she ordered one of her secretaries to translate it into Russian, and then deliver it to me to be conveyed to the asylum, and entered into the journal there for immediate adoption. I remember, on one occasion, taking a list of rules, at least 14 in number, and the same day they were confirmed by the Empress; and these rules introduced the following important arrangements, viz.: The treating the inmates, as far as possible, as sane persons, both in conversation and manners towards them—to allow them as much liberty as possible—to engage them daily to take exercise in the open air—to allow them to wear their own clothes, and no uniform prison dress—also to break up the inhuman system of permitting the promiscuous idle curiosity of the public, so that no one was allowed to see them without permission; a room on entering the asylum was prepared for one at a time, on certain days to see their relations. The old cruel system drew forth many angry expressions from the poor lunatics, "Are we wild beasts to be gazed at?" . . . . Another important rule of your mother's was, most strictly to fulfil whatever you promise to any of the inmates, and above all, to exercise patience, gentleness, kindness and love towards them; therefor, to be exceedingly careful as to the character of the keepers you appoint. These are some of the pleasing results of your mother's work. The Dowager Empress on one occasion, conversing about your mother, said, "How much I should like to see that excellent woman, Madame Fry, in Russia."

Her health was never very strong, but even when ill she could not restrain herself from trying to put right what she thought was wrong. On one occasion, in 1824, when resting at Brighton, she noticed the great number of beggars and how the charity was given indiscriminately, and seemed to be doing more harm than good. To meet this she organized the charitably disposed among the different religious denominations into the "Brighton District Society," which was, in effect, a charity organization society, and, so far as I know, the first one ever formed. After this she was instrumental in establishing similar ones in many other places.

It was during this stay at Brighton, while she was suffering from frequent attacks of faintness at night, for the relief of which she was often taken to the window of her room overlooking the sea, that her sympathy was aroused by the constant sight of the blockade man, or coast-guard, pacing the beach. She thought how lonely and isolated his life was and wondered how she could help him. She took the first opportunity of speaking to one of these men, but discovered that it was against orders for the men to speak to any stranger, as their duty was to prevent smuggling. To protect the man she gave him her card with the request that he give it to his superior officer. Some days later she was much pleased to receive a visit from the naval lieutenant in charge of the station and he explained to her the nature of the service. Mrs. Fry with her clear insight at once thought of a plan, probably the best, that might alleviate the hard lot of the coast-guards—she established libraries containing the Bible and other books. The libraries became very popular and were distributed throughout England. Another national society was formed to look after the interest of this work. Official sanction was given and certain grants allowed. The report of the committee in 1836 shows the magnitude to which the work had grown. This report ends as follows (Memoir, Vol. II, p. 229):

The means thus so liberally afforded, have enabled the committee to provide and forward to the coast,

498 libraries for the stations on shore, containing	25,896 vols.
74 libraries for the districts on shore, containing	12,880
48 libraries for the cruisers, containing	1,867
School books for the children of the crews of stations	6,464
Pamphlets, tracts, etc.	5,357 in No.
Making a total of	52,464 vols.

and thereby to afford a body of deserving and useful men and their wives and families (amounting to upwards of 21,000 persons) with the means of moral and religious instruction, as well as profitable amusement, most of whom, from their station in life, have not the means of procuring such benefits from their own resources, and who, in many instances, are so far removed from places of public worship and schools, as to prevent the possibility of themselves or their families deriving advantage from either.

Mrs. Fry's interest in public institutions spread over the whole of England, Scotland and Ireland, and many branches of the British Ladies' Society were started in all of these countries. In 1835 she extended her influence to the Channel Islands and visited them again in the following year. The acts of Parliament pertaining to prisons did not apply to these islands, and their prisons were in a lamentable state. As usual, she was able to suggest many improvements in their management that could be and were carried out. Many of her correspondents urged her to visit the Continent and give them the aid of her experience and personality. She felt it her duty to comply with this call, and in 1838 she began her "Visits of Gospel Love" to Europe. She made five such visits, and, as Friends would say, the way was wonderfully opened for her. Those in authority were nearly all more than anxious to have her visit their institutions to suggest improvements. The various royal families received her most cordially and appeared to delight in her society. She must have made a picturesque figure in such surroundings, dressed as she was in the simple elegance of the plain Friend which harmonized so perfectly with her erect carriage, her dignified bearing and her earnest, sympathetic face. Her principles did not allow her to do many of the things that were considered necessary in court, but this seems to have made no difference. Royalty in general seemed more pleased that she advised them and prayed with them than if she had kissed their hands. She suggested many things about the conduct of their prisons, asylums and hospitals, told them of her views as to the

religious state of their kingdoms, and when there was religious persecution—as was frequently the case—she pleaded for religious freedom. All this she was able to do with such wisdom and tact that her counsel was accepted in the spirit in which it was given and very frequently was acted upon.

She visited the Prussian Court twice, in 1840, where she was received with peculiar consideration, and when the King of Prussia, Frederick William IV, visited England in 1842, to stand sponsor for the Prince of Wales (the late King Edward VII), he insisted, somewhat to the consternation of those who had charge of his entertainment, in spending much of his time with Elizabeth Fry. He requested that she dine with him at the Mansion House, went with her to visit Newgate Prison, and then took dinner with her and her family. He was heard to say, "She is the best friend I have in the world."

Little did Betsy Gurney think when she renounced the pomps and follies of the world and adopted the customs of plain Quakers, that the path she had chosen was to lead her so often to the seats of the mighty!

Although Elizabeth Fry saw many things to criticize in her journeys to Europe, she also found things to commend and she met with many earnest workers for the amelioration of the distressed. It was during her first visit to Germany that she visited Pastor Fliedner's establishment at Kaiserwerth—an establishment for the training of nurses, the first secular one that had ever been established. Fliedner had corresponded with Mrs. Fry, had visited her on two occasions and seems to have been much influenced by her example. Mrs. Fry, on her part, upon returning to England followed his example and established the first band of professional nurses in Great Britain. She herself could not take a very active part in it, but her sister, Mrs. Samuel Gurney, and some other ladies took the management of it. When not engaged in nursing, the "Nursing Sisters" resided at "The Home," in the city. They wore a plain but inconspicuous dress and were maintained and paid by the institution, but were not permitted to receive any money or gifts under any circumstances for their attendance in illness. The funds of the Society were small and were derived partly from subscriptions and partly from the liberality of those who were benefited.

The intimacy between Elizabeth Fry and the other members of the Earlham family never waned and she paid frequent visits to Norfolk. Her sisters for the most part differed from her in religious matters, but this difference was never allowed to cause any break between them. Whenever there was illness, Elizabeth Fry, when possible, nursed the sufferer in a peculiarly sympathetic, skillful manner. However strict she may have been with herself, she was more than lenient with everyone else and had a never-failing sympathy. This to some extent must have been due to the fact that she herself suffered frequently from bodily ills, particularly those most troublesome ones of a nervous nature, and she had a most unusual insight into such troubles.

In the Memoir[2] her daughters have included in the extracts from her journal a number of notes which bear on her bodily state. These give some idea how, in her case, a peculiarly nervous, sensitive nature was controlled and directed and made most wonderfully effective by a firm religious belief. These extracts are probably only a few of many similar ones to be found in the original journal, but they are, I am afraid, too many to be included in this paper, and so I have been forced to select some which seem most interesting. I have already read you her own recollection of her childhood in which she speaks of her childish fears and nervousness. When she was 18, during her religious awakening, she shows in the following extract how she was struggling against her morbid fears:

Jan. 4, 1799. A plan, at least a duty, that I have felt for some time, I will now mention. I have been trying to overcome fear; my method has been to stay in the dark, and at night to go into those rooms not generally inhabited; there is a strange propensity in the human mind to fear in the dark, there is a sort of dread of something supernatural: I tried to overcome that, by considering as far as I believed in ghosts, so far I must believe in a state after death, and it must confirm my belief in the Spirit of God; therefore if I try to act right, I have no need to fear the directions of Infinite Wisdom; I do not turn away such things as some do. I believe nothing impossible to God, and He may have used spirits as agents for purposes beyond our conceptions; I know they can only come when He pleases, therefore we need not fear them. But my most predominant fear is that of thieves; and I find that still more difficult to overcome, but faith would cure that also, for God can equally protect us from man as from spirit.

Before and after the birth of each child she usually suffered a period of depression, accompanied by great bodily weakness and a terrifying apprehension of death. After the birth of her second child, when 23, she writes:

Plashet, Fifth Month, 21st, 1803. I have long been prevented writing in my journal, by a severe attack of indisposition. It is difficult exactly to express what I have gone through, but it has been now and then a time of close trial; my feelings being such at times as to be doubtful as to whether life or death would be my portion. One night I was, I believe, very seriously ill; I never remember feeling so forcibly how hard a trial it was in prospect to part with life. Much as my mind, as well as body, was then tried in this emergency, still I felt forcibly an inward support, and it reminded me of that text of Scripture, "Can a woman forget her sucking child, yea they may forget; yet will I not forget thee." And then I told those around me, that I was so ill, I could almost forget my child, but I felt the existence of a power that could never forget. I have gone through much since, in various ways, from real bodily weakness, and also the trials of a nervous imagination: no one knows but those who have felt them, how hard they are to bear, for they lead the mind to look for trouble, and it requires much exertion not to be led away by them; nothing I believe allays them so much as the quieting influence of religion, and that leads us to endeavor after quietness under them, not looking beyond the present. But they are a regular bodily disorder, that I believe no mental

[2] **Memoir of the Life of Elizabeth Fry. Edited by two of her daughters. London, 1847.**

exertion can cure or overcome, but we must endeavor not to give way to them.

Again six years later she records:

Seventh Month, 27th, 1809. I am much better than I was, but I have believed, in these trying complaints to which I am liable, that the less I look outwardly for help the better; as I do not believe any doctor can do much for me. I feel the best satisfied when I simply endeavor to bear them patiently; I think I know myself, what is the best to take for them: they appear to be principally nervous, which I consider to be beyond the power of man either to understand or cure; but how often have I experienced true spiritual support and help, when I have endeavored patiently to wait on the source of good: and the mind being so nearly connected with the body, whatever tends to tranquillize it, really helps the complaint.

She often was pursued by the thought that possibly her nervous depression might be due to a lack of faith, and an evidence that she was in some way untrue to her religious standards, although her intelligence told her that the condition was largely a physical one as is shown by the following extract:

Plashet, Fourth Month, 30th, 1814. None know but those who suffer from them the deep humiliations such disorders create, as those I have lately had; I mean great bodily weakness, accompanied by nervous lowness of spirits, and much mental fear. In the first place, how deeply do they try us, being in their own nature so painful; in the next, from the difficulty in doing strictly right in them, how far to endeavor to divert by cheerful amusement, or by taking such things as may soonest relieve them; and added to these, I think many are apt falsely to accuse themselves, and to mistake the painful restlessness and fear occasioned by them, for impatience and mistrust; I have sometimes a hope that this is not my case, though at others great fear arises, lest I should in any degree let go my hold, or be impatient after having so abundantly known the goodness, the loving-kindness of the Almighty. Oh, saith my soul, may He once more revive the spirit of His poor unworthy one, and breathe upon these dead bones, that they may live.

The neurotic disposition seems to have been an inherited tendency in this remarkable family, and Elizabeth Fry, when 53, wrote to one of her daughters, who was evidently suffering, the following helpful and encouraging letter:

(1833.) I feel in the first place, earnestly desirous that thou shouldst think as little as possible of thy nervous feelings. I know how extremely painful they are, but experience has taught me, the less I think of them the better. It is most important to look upon them as much as possible like the toothache—that it must be endured while it lasts, but it is not dangerous in its nature. As for the discolored view, the imagination may at times give to things, nothing is more important than to set it down as a clear and fixed thing in the mind, that whilst this nervousness lasts it is not sound, and must not be believed or taken heed to. I would not have thee discouraged at this return of it. I believe I never had death brought home very closely, without being brought into a low nervous state, it is after all so awful; though I increasingly see, that this is real weakness, and that those who are believers in the Lord Jesus, however unworthy, need not fear it, as through Him its plague and sting will be done away. But it is folly in one sense to look ahead, we have enough to do to seek for help and grace for the present time to do our present day's work. When the day comes that we have to give up "this mortal life," we may and ought humbly to trust, that through the unmerited mercy and love of our Lord, His grace will be found sufficient for us. I observe, for my great encouragement, that what we call nervousness often proves no common blessing, if made a right use of, and not given way to. It so wonderfully humbles, prevents the creature glorying, and makes willing to do anything to come to that peace, which quiets every storm. Thy uncles and aunts have nearly all been striking instances of this: and I believe, hard, very hard as it is to bear, it is a baptism to fit for a fulness of joy and glory rarely partaken of; but it in no common degree calls for patience. I always think both David and Paul largely partook of this sort of humbling experience. Therefore my dear . . . . if tried this way, possess thy soul in patience, and look upon it as a suitable, though bitter, medicine prescribed by the Physician of value to promote thy health and cure.

She always, while engaged in her various philanthropic activities expended her strength most lavishly, and afterwards she usually had periods, often long ones, of great suffering. Together with the physical weakness, the accompanying mental depression was often combined with the fear that she had received far too much personal adulation, and that she had perhaps put herself forward unduly. She was glad to use the power of her reputation and position in the furtherance of her projects, but was very fearful that she might take to herself—the instrument—the credit that was due to her Lord, and she at times looked upon her illnesses as corrective agencies.

As she was returning from her second visit to Germany, when 61, she writes, in a letter to her husband and children, the following:

Cassel, Ninth Month, 26th, 1841. I have continued very far from well, with latterly a considerable stiffness in my limbs, so that I am obliged to be assisted to walk upstairs, and helped into the carriage, sometimes by one or two men. I might have had the same attack at home; but one thing is certain, we may fully trust in our Heavenly Father, who is constantly protecting us under the wing of His love, and who knows what is best for us. I have sometimes thought that after being so helped on my way, from the palace to the prison, it was likely that the poor instruments should need a little further refining and purifying, for our works are to be tried as by fire. I have very earnestly desired not to repine, or to be unwilling to drink the cup that may be given me to drink. We travel with six horses to make the greatest speed home. I have a board in the carriage, that when your uncle and Anna are outside, I can quite rest and make a real sofa of it, when I need it, which I do for one or two stages in the day. Mary and François are very attentive and kind; indeed how differently am I cared for to many poor missionaries. I wish you to feel for me, but not to be too anxious about me; commit me entirely to Him who only knows what is best for me. Your aunt Elizabeth's letter was very seasonable and acceptable. I wish her and all my children to know how it is with me, for I need their sympathy and prayers, at the same time that I feel the best help to be near, and the Power that says to the waves "So far shall ye go and no further." Often in my wakeful and at times distressing nights, a sweet peace comes over me to calm my troubled spirit. We hear from newspapers, that the poor Baptists in Copenhagen are to be released from prison, a small sum being paid by way of fine. What a comfort! and the poor Lutherans in Prussia say they are now so well off, that they do not wish us to ask for any more liberty for them from the King.

After this visit Mrs. Fry's health improved but slowly and, although far from well, she felt it her duty to go again to

France in 1843. Upon returning from this visit her health failed rapidly and she was practically an invalid from then until her death, although she was able to continue her correspondence and at times to take part in the various national societies she had founded.

Among the number of interesting references in the Memoir to this time I can only include the following:

> One afternoon, when one or two members of her family were reading to her, she was unable to attend to a very interesting religious biography, saying, it was too touching to her—too affecting. She added, after a pause, "How I feel for the poor when very ill, in a state like my own, for instance, when 'good' ladies go to see them. 'Religious truths so strongly brought forward, often injudiciously.'"

As she became weaker her fear of death decreased and to one of the "Nursing Sisters" she thus expressed herself, "I am of the same mind as Paul, I can say, 'to me to live is Christ, but to die is gain.'"

Shortly before her death her daughters record a marked change in her dominant disposition:

> There was another wonderful change. Her powerful understanding and great capacity had given her the habit of control—she was accustomed to power. During her long illness, this continued more or less to show itself, and it was not always easy to distinguish how far her opinions about her own treatment and capabilities were well founded or not. This feature of her character had disappeared. The will seemed wholly broken, the inclination to resist, or even strongly to desire anything, passed away; and she was content to leave little things and great to the direction of others. It was inexpressibly affecting to see her look of meek submission, to hear her plaintive answer, "Just as you like," to those about her.

These extracts that I have read show clearly how much Elizabeth Fry suffered throughout her life from her peculiar nervous organization. For two years before her death in 1845 she was an invalid, confined practically to her bed or chair. Exactly what organic trouble she had, I have been unable to determine, for her daughters speak only in very general terms of the symptoms. She became less and less able to take any active part in the various movements she had been instrumental in starting. She, however, attended Meeting whenever possible, often when she was too feeble to leave her wheelchair, and it is said that her mind remained remarkably clear in regard to her ministry, even when she found it very difficult to concentrate her attention on other subjects.

During the last months of her life she appears to have suffered intensely, and her strong will seems to have become passive, but her condition did not become acutely alarming until three days before her death when, I think, she must have had a thrombosis of the cerebral blood vessels. She gradually became unconscious and died October 12, 1845.

Elizabeth Fry's religious faith never wavered, nor did she ever regret having become a plain Quaker. She suffered much for her principles, particularly from the fact that many of her sisters and brothers could not see as she did and that most of her children separated themselves from the Society. Her eldest son renounced his membership and others were disowned for marrying out of Meeting. She believed most strongly that young people should be left free in their choice in marriage and encouraged her children in this by her sympathy and love. She felt as a minister of the Society of Friends that she could not go to their weddings, but she did attend the Meetings in which their names were taken from the list of members.

She was thrown much with earnest people of all denominations and had no trouble in uniting with them all. Her attitude to others was one of love and helpfulness, but of herself she was a severe critic. Although she felt it right for herself to conform rigidly to the customs of Friends, she regarded it as a personal matter, and saw clearly that such conformity might be a stumbling block to others, particularly to the young. She had little patience with the empty forms of piety, whether in plain Quaker or in the most ritualistic of priests. Her religion was one of service and she truly followed George Fox's injunction, "That which Friends doe speake they must live in."

Augustus Hare (Gurneys of Earlham, Vol. II, p. 201) writes of her wonderful tenderness:

> Mrs. Fry used pathetically to say at this time that she had been "undermined by excessive love," an expression touchingly significant of the secret spell of Elizabeth Fry—the spell which unlocked the hearts of kings to her, and caused the prisoners' chains to fall off at her approach. She had been no professional philanthropist, too much absorbed in humanity at large to care for the human item, but the public work had been, as it were, only the overflow of her woman's heart, the expression of the fulness that remained after children, grandchildren, brothers, friends, had been loved with an intensity which to her eyes seemed "excessive," almost sinful. This marvellous tenderness it was, thrilling in the tones of a voice whose natural music would have been almost sufficient to melt and convince, which had been the key to her influence and power—this, and her sweet humility of soul, her child-like, single-eyed devotedness.

This certainly accounts for the charm and appeal of her personality, but her effectiveness was due, I think, to the fact that she had a most remarkable faculty of grasping a situation and knowing, seemingly intuitively, what under the circumstances should be done to meet it. This is genius, and when genius is activated by Christian love what may it not do and who of us would not gladly follow?

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